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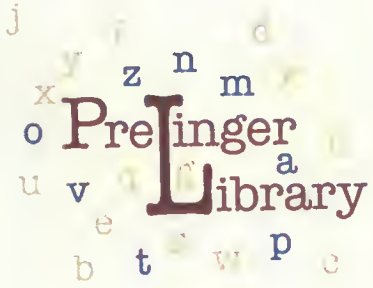

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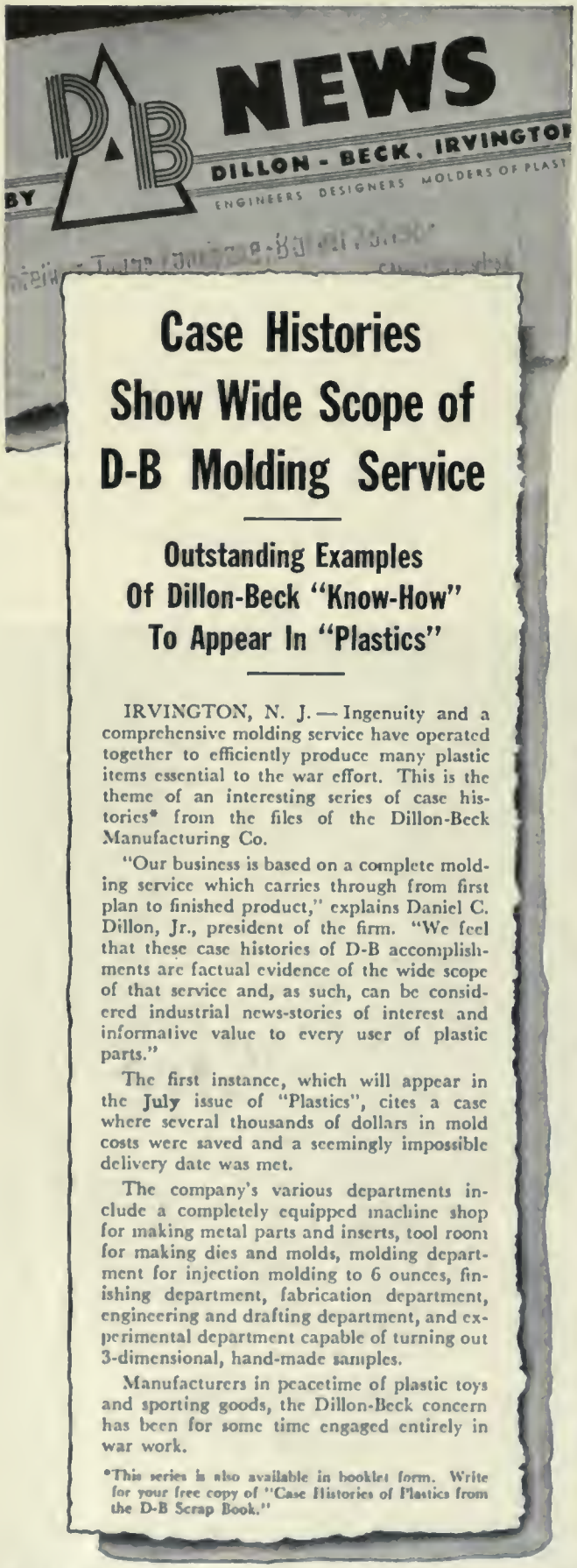

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FRONT COVER: Book ends, clockcase, candelabra, cigarette box and holders are cast of Catalin.

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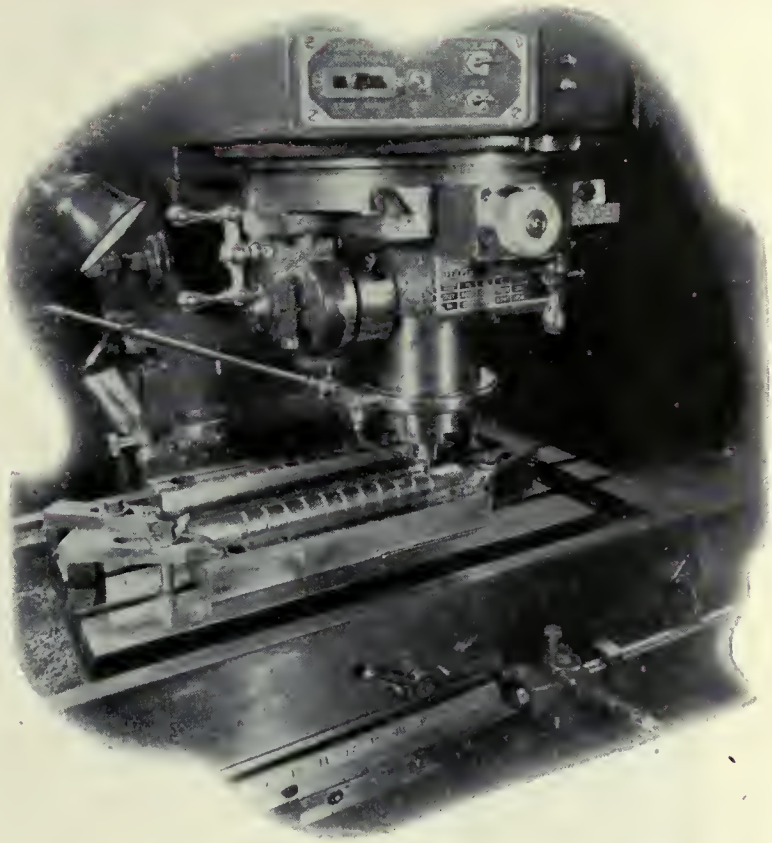

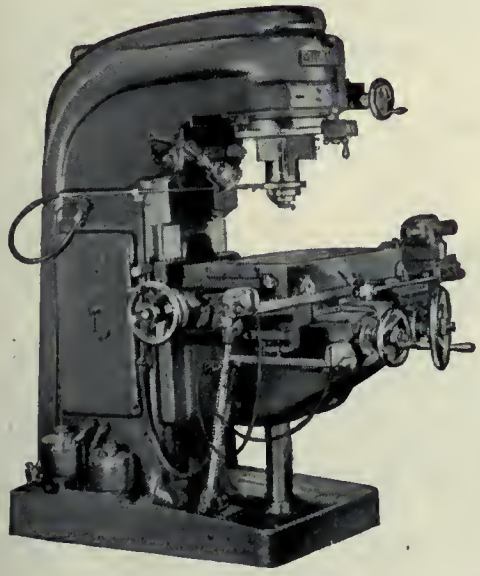

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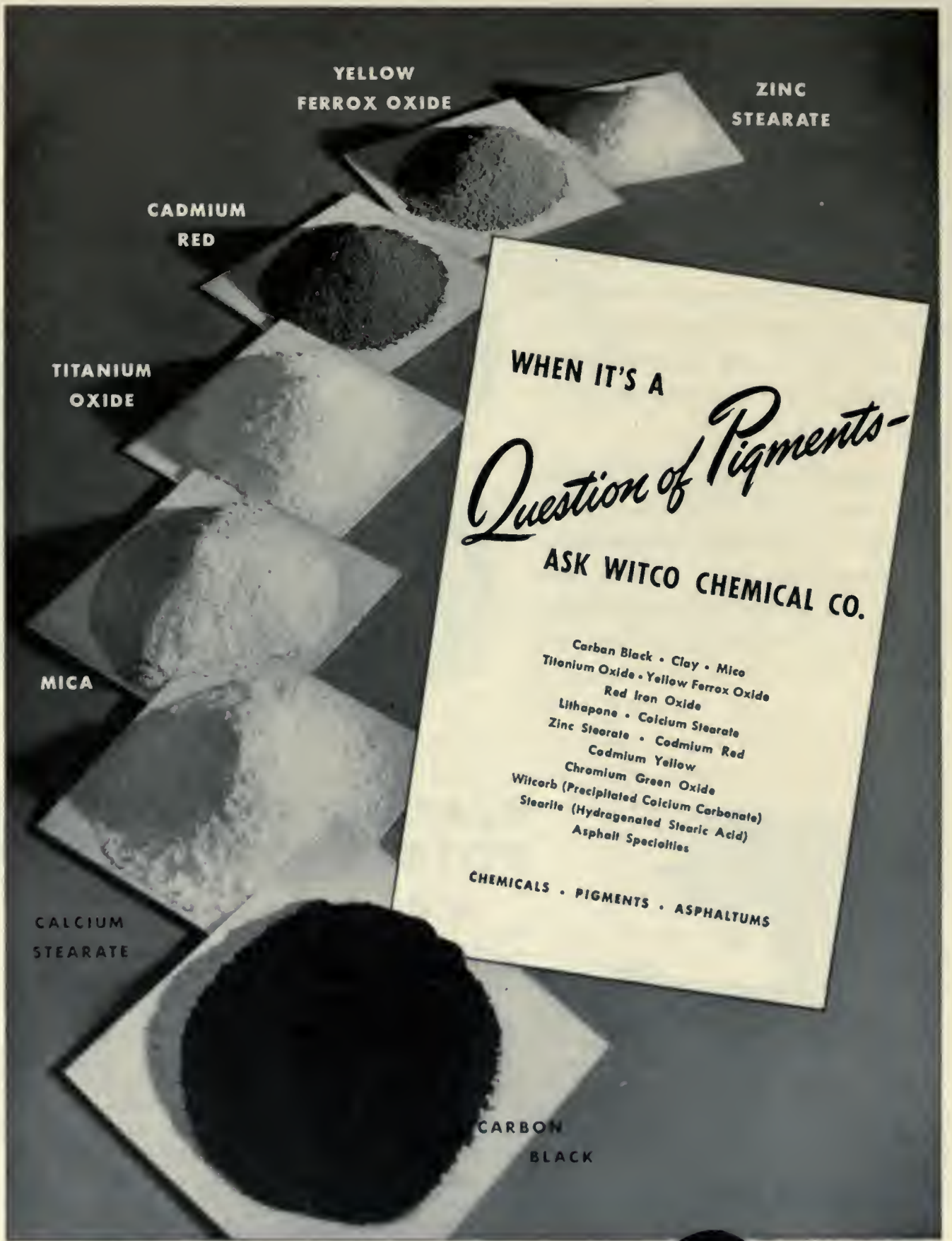

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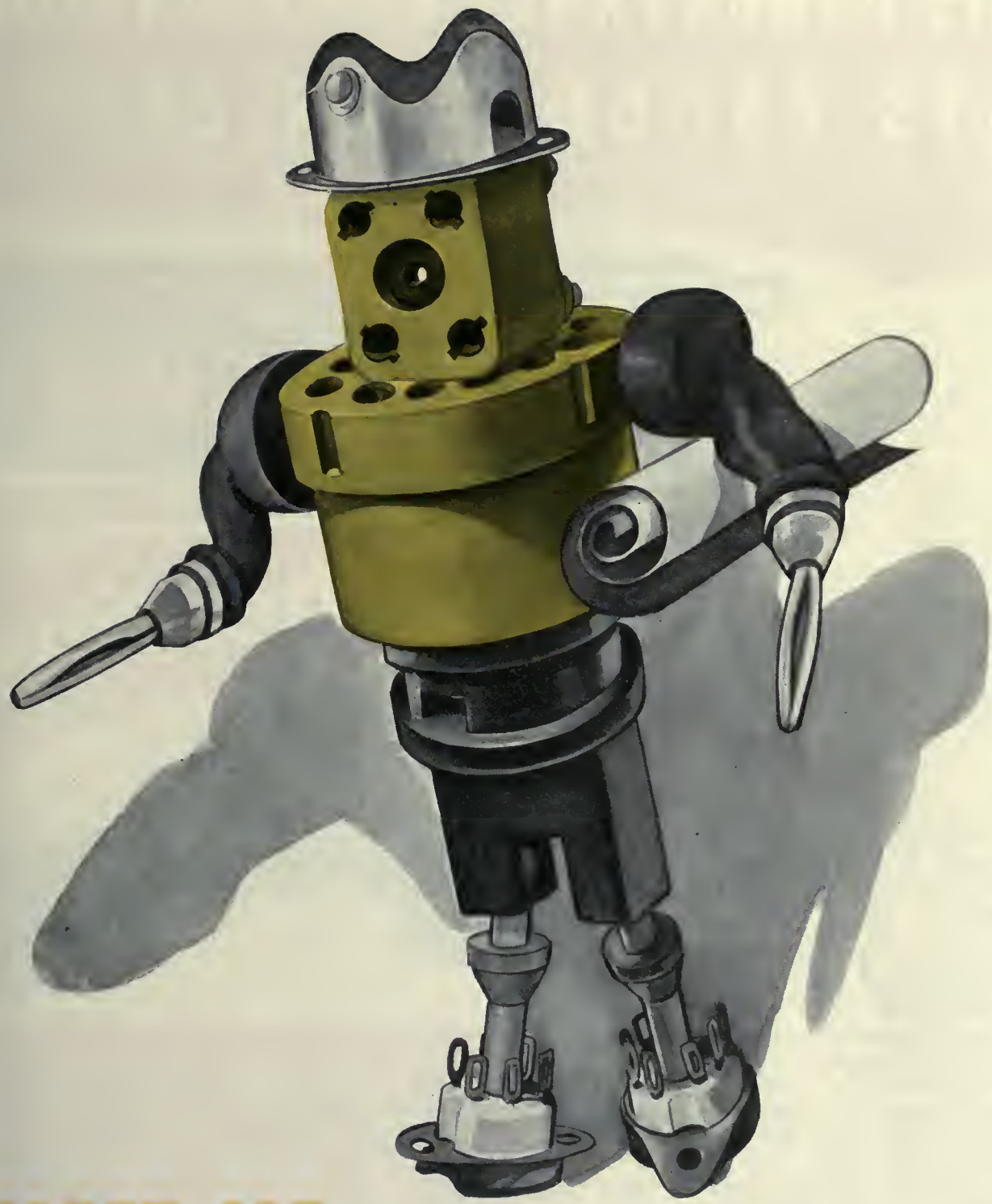

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SPECIMEN NO.	H. F. HEAT	CURE	TOTAL % ACETONE EXTRACTIVES
1	40 Sec.	120 Sec.	2.4
6	40 "	42 "	2.6
9	41 "	20 "	2.0
13	40 "	23 "	2.0
Standard	None	5 Min.	2.1

(Weight of Charge 220 Grams)

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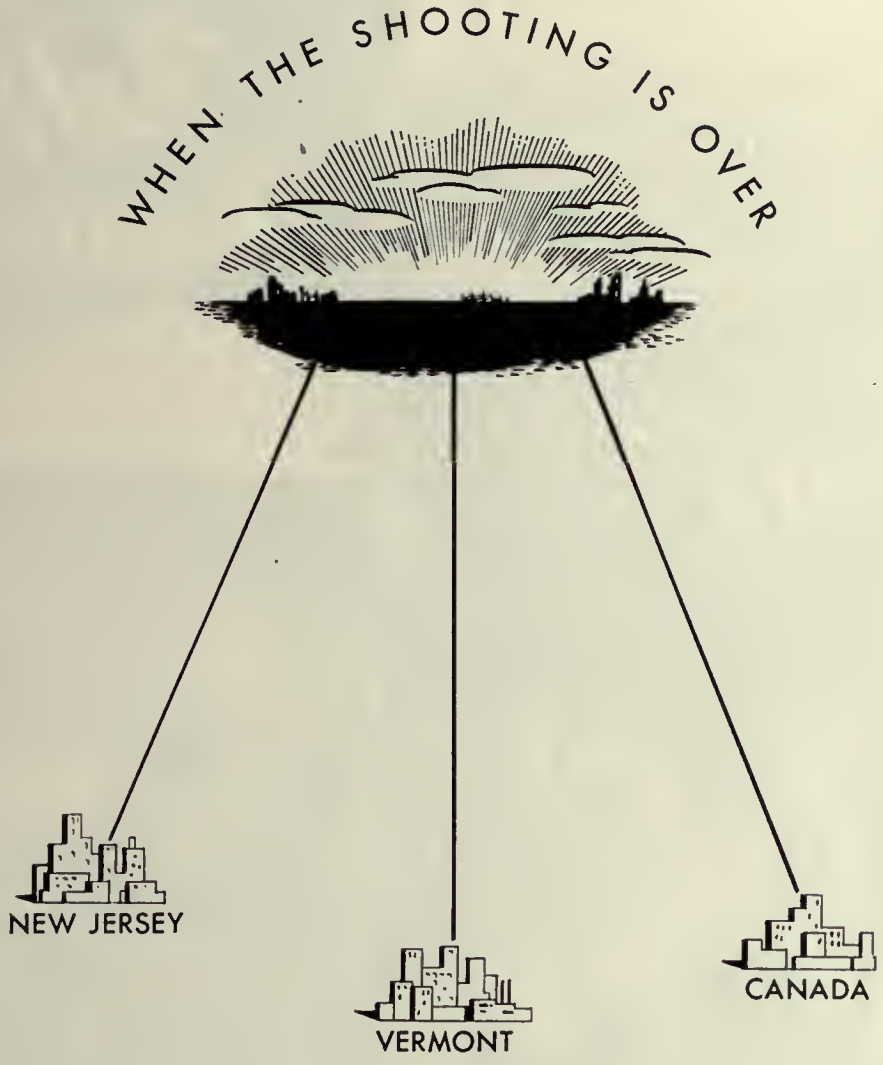

WHEN the war is over a great new day for plastics will be born. The three strategically located and *qualified* plants of the Mack Molding Company are now engaged in vital production that is taxing the limits of their capacity . . . *come the peace* . . . the great pool of knowledge and experience we have gained will be extended to you for the solution of your plastic molding problems. If our present war production is a barometer, many plastic problems will be problems no longer. Again Mack Molding will be producing for you in limitless quantities . . . quickly, efficiently, and economically. Your inquiries concerning vital production now, or peace-time planning, are invited. Sales offices in principal cities.

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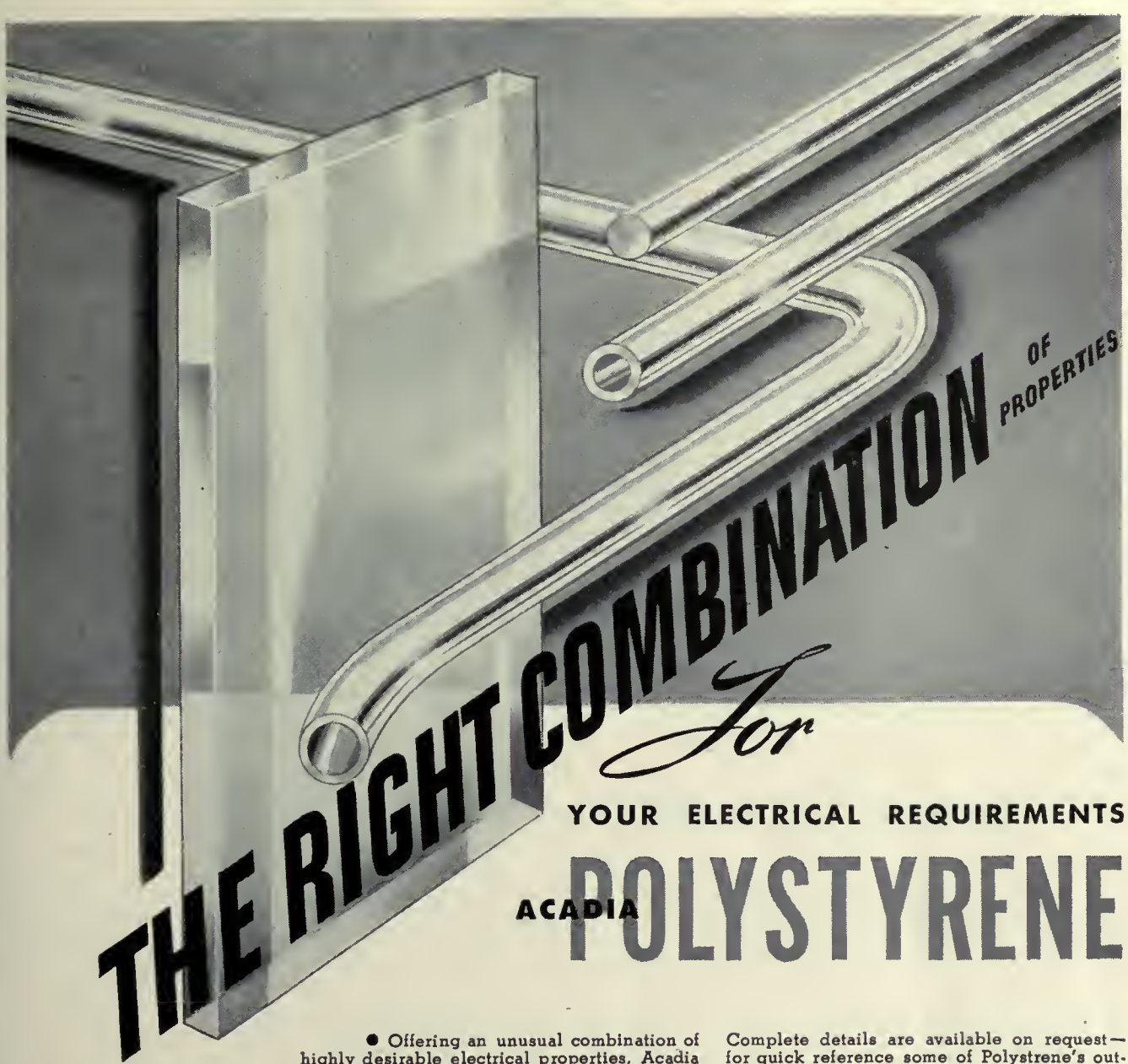

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	2.5 to 2.6 at frequencies 10^6
Power Factor, 60 cycles	.0001 to .0003
10^3 cycles	.0001 to .0003
10^6 cycles	.0001 to .0008
Dielectric Strength, Volts/Mil ⅛" thickness	
Short time	500 to 700
Step by step	450 to 600
Volume Resistivity, ohms-cms	10^{17} to 10^{19}
Heat Resistance	150°F to 175°F
Softening Point	190°F to 250°F
Specific Gravity	1.05

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Send for complete data giving physical properties of Acadia Polystyrene, plus a table of specifications on its electrical properties.

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PLASTICS in PERSPECTIVE . . . . . .

BUSY as it is with war volume, the plastics industry goes right on developing new materials and harnessing other materials to new jobs. The immediate benefit is to the war effort; the long range benefit will be to expand the post-war use of plastics. A look at the newer materials is convincing.

The new "toughie" in the thermoplastics group, polythene, is better known in England where it has been in use much longer than here. With polythene having gone wholly into war production, it will be a while longer before we find out all we'd like to know about it. Its military uses could give us a good idea of its possibilities, but Uncle Sam thinks it's wiser to keep them to himself for reasons of security. On top of that, there's only enough of the ethylene monomer to go around for making polythene for military use and for some experimentation.

Polydichlorostyrene adds a high-heat resistant member to the heat resistant and dielectrically strong styrene family. This new material paves the way to a broader use of styrenes in radionics, electronics and other fields where heat is a factor.

New bonding and impregnating plastics developed for the field of laminates are bringing unprecedented strength to organic materials. A new helper in the laminate field is a furane resin recently introduced on the West Coast.

Many husky tool shop pieces, from drop hammer punches to jigs, are being poured from ethyl cellulose and phenolic resins. Ethyl cellulose is getting a new reputation as a workhorse plastic in addition to its being well known for flexing stamina. Another important but less known application of ethyl cellulose is as a "brushing on" liquid in bonding and coating of laminates for load bearing and structural performance.

From many directions, interested eyes are watching elasto-plastics and they see in them the elasticity of rubber combined with the characteristics of plastics.

Greater and more stable transparency developed in cellulose acetate found a more important place for it in aircraft. This use indicates that this popular plastic will be given certain optical jobs to do in post-war.

Electroplating of plastics may soon demonstrate more than we can talk about. From the adoption of electroplated plastics to shielded units of radio and ignition circuits, you get an idea of how this development can add millions of new units in plastics.

Those recent developments in plastics and the many "unmentionables" that will become mentionable when war censorship lifts, make a sizable running total to be forwarded for a good post-war beginning.

•

THE changing models of equipment demonstrate that machinery builders are following through to give molders the wherewithal for applying new developments. Electronic preheating is catching on, too, about as fast as war restrictions and manpower adjustment allow. It is estimated that there are about 40 electronic preheating units, excluding home made units, among some 700 molders.

IF we're to judge a plastics age by what it begins with, what it ends with and what goes between—it's here! The transparent bassinet of cellulose acetate provides a sanitary enclosure for the newborn and yet hides none of his antics from his admiring parents. . . . The infant soon fondles a rattle blown in cellulose acetate and gadgets molded of the same material. . . . As life goes on, the youngster is introduced to more plastics: The comb of cellulose nitrate, the acetate toothbrush with nylon bristles. . . . Then the childhood stage with its myriad of plastics toys. . . . And mom and dad have a movie record of it all on cellulose acetate film; it shows his first meal from plastic dishes.

In boyhood, the utility plastics come into his life. . . . Lessons on the plastic "blackboard"; home work on the plastic "slate." . . . Piano practice on the plastic keyboard . . . The handsome plastics pen and pencil set for graduation into high school where the problems of math, chem and physics are worked out with instruments of plastics. . . . And so on through college. . . . On the nights out with dad's car, "Junior's" transportation and amusement utilized plastics from the moment he stepped on the starter until he switched on the car radio and relaxed.

For the rest of his span of life, he takes plastics for granted, they are all around him—on the switch that turns on his bedroom lamp, the connectors and relays of the current supply that lights it, the shade that diffuses its light. . . . The plastic alarm clock is replaced by reveille on a plastic bugle when he goes to war—trained, transported and outfitted with equipment using many plastics.

This generation now sees plastics concerned with life's end, too. The sturdy plastics casket, secure from mildew and the corrosion by soil acids—and resistant to seepage, helps those left behind to find a consoling thought. Wouldn't you say this constitutes the "plastics age"?

•

THE new molding technique of vacuum and "snap-back" forming is destined to extend the use of thermoplastics into markets formerly belonging to sheet metal stamping. The fabrication of thermoplastic sheets into large housings, covers and other formed sections—through the use of a single inexpensive die, or with no die at all—is a reality. The complete details of this new achievement in plastics progress appear, for the first time, in this issue on Page 22.

•

THE liveliest post-war planning is being done in the studios of product designers. Their drafting boards are kept busy by manufacturers who are going into complete product redesign for the time of post-war reconversion. These manufacturers don't intend to begin where they left off by pulling old dies from the shelves and dusting off pre-war designs from drafting room pigeon holes. They are thinking in terms of having a merchandising edge in post-war with redesigned products using plastics to best advantage. (*Continued on page* 112)

Put IND

In Your Post-War Planning

For here is an organization which under the fast tempo of plastics for war production has been developing as well as producing . . . new processes . . . new and revolutionary uses and their application to your needs. When the war is over and the last battle is won — — — INDUSTRIAL MOLDED PRODUCTS and its staff of specialists will be important to your planning . . . to coordinate their research in compression molding to your product problem. For the future . . . plan on plastics and the Industrial Molded Products Company.

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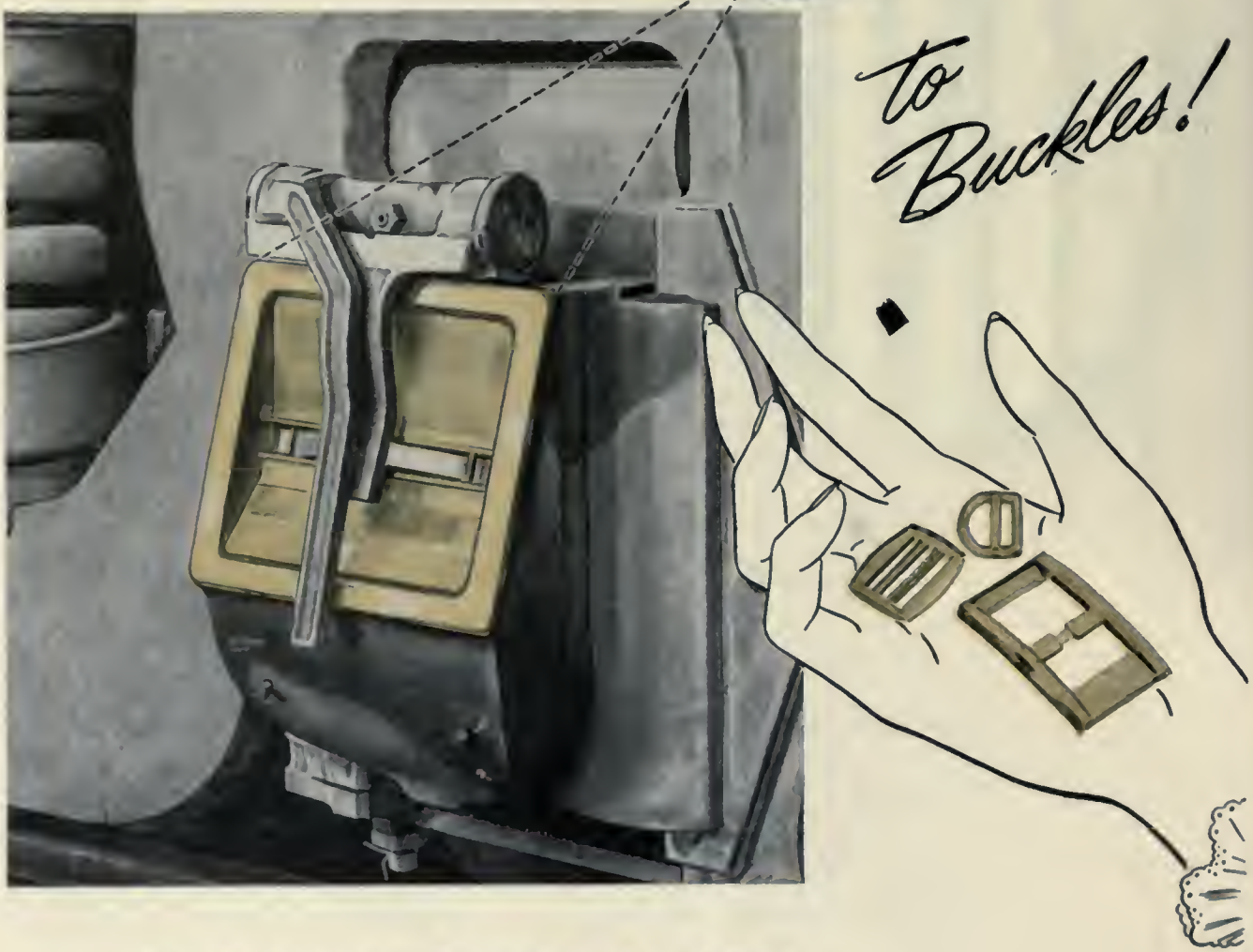
FROM BOXCARS . . .



to Buckles!

IN PLASTICS MOLDED BY AMOS . . .

There are not yet any examples of molded plastic boxcars. There are many examples of utilitarian and decorative buckles. But boxcars *do* ride on wheels which *do* have molded plastic covers for their journal boxes. Plastic replaced iron for this job because it did a better job—provided a better seal of the box to keep grease in and dirt out. It is but another example of the big jobs plastics can do in teaming up with, or replacing metals—to advantage. Plastics make beautiful, colorful doo-dads—but they can do rough work, too. When you begin on the design of a new product, give consideration to plastics—and write for our helpful and informative booklet "Will You Use Plastics?"—a valuable source of general and technical data on molded plastics. Write us today!

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Custom Molders of Parts and Products by the Injection Process

Wartime Developments of PLASTICS MATERIALS

One of the many wartime plastics applications—the strong, resilient, vinyl plastic tow-rope, hauling personnel and cargo gliders

By E. F. Lougee

PRODUCTION FOR WAR HAS GIVEN GREAT IMPETUS TO INTRODUCTION OF NEW MATERIALS AND NEW APPLICATIONS WHICH WILL EXPAND PLASTICS INTO MANY MORE INDUSTRIES IN POST-WAR

The author has served the plastics industry as journalist, consultant and educator since 1924. In 1940 he organized the Advisory Board of the Plastics Institute of which he is chairman. His intimacy with the many developments in the plastics industry since its early stages of expansion, has made him an outstanding contributor of authoritative writings on materials and methods.

TUCKED away in hard-to-find corners of huge aircraft plants, serious young men spend long days fastening things together and tearing them apart again, not as a pastime but in a desperate effort to find better adhesives and ways to apply them. Riveting, the bottleneck of aircraft and ship production, has given way to more rapid welding in many places. Shipyards tried it and production jumped. Aircraft tried it, but only in places where welding would do as well. The number of places was comparatively small. Now, with plywood and fabrics supplementing metals, the search is on for the perfect plastics cement.

Chemists, creators and developers of plastics materials, are growing bald and baggy-eyed in their struggle to meet the problem because they know that markets for plastics adhesives extend far beyond present needs, into postwar fields which will keep their factories humming if their research succeeds. Much progress has been made. Plastics cements that required tremendous pressure and heat to cure have been shoved aside by more rapidly curing cements where catalysts speed polymerization and little or no pressure is required.

When presses were discarded for the more versatile rubber bag and clamp pressures, size limitations for plastics bonded plywood were extended so that sheets of unprecedented proportions in wide variations of shapes became practical. The plywood trainer and Mosquito Bomber show what can be done. Although the plywood trainer got a "kayo" decision from Army officials in this country, the Mosquito Bomber is still giving a good account of plastics bonded aircraft in the bombing of Europe and it was this construction medium that provided England with fast-built planes when they were needed most. Never was so much owed to so new a product,

and rarely was a product more vigorously tested.

The immediate struggle is for rapid, permanent bonding of canvas, paper, glass, and fiber laminates for semi-structural parts. Many have been made and production is increasing every day. Ureas, phenolics, allyl alcohol, and furane cements give these fillers properties they never had before. They produce laminated structures that are resistant to moisture, fungus growth, salt spray and other destroying elements which found old style plywood easy to lay low after a few months' service.

Ureas, phenolics and allyl alcohols are well known. Their properties have been recorded in detail. Furane (or furfural) resin is comparatively new. Its raw materials are abundant and many chemists are working on its application in bonding and impregnating fibrous materials. Its future looks bright. Recent tests for one compound indicate that "glue lines" are stronger than the plastics it bonds. Phenolic canvas laminates cemented together with furane cement will tear at the canvas line rather than give way at the bond. Rubber cemented to acrylic sheet with furane resin will be destroyed itself before it will release its bond. Aluminum cemented to aluminum will withstand a pulling tension of 3500 psi. This is not to say the ideal adhesive has been found. It means simply that better adhesives are being developed by researchers and there will be no stopping them until it is found.

Furane cement impregnates rapidly because it is not viscous. It lends much of its strength and moisture resistance to wood, paper, fabric, or whatever it sticks together. Ordinary plaster of Paris impregnated with furane resin gains 400 percent in compressive strength; makes it cheap and fairly suitable as jigs and dies for forming metals and wood veneers. Reason is, it contains no volatiles to be driven off during polymerization. It doesn't blister or warp. It cures at room temperature but the cure can be speeded by oven heat.

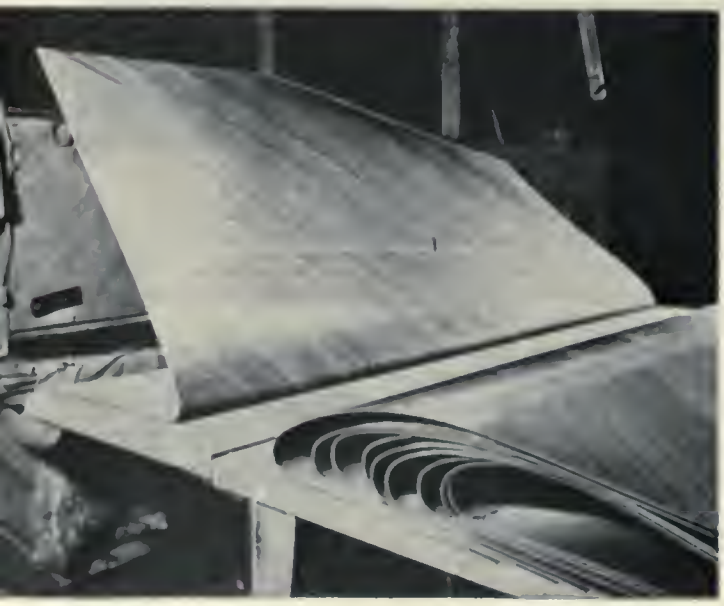
What does all this mean in post-war?

It means that many things which were formerly glued. welded, dowelled, or nailed, will be bonded with plastics adhesives. It means that many things which once were built up piece by piece will be molded as integral units with savings in man hours, weight, and cost. Prefabricated rooms, houses, beach homes, mountain cabins, garages, commercial buildings, may not be as far distant as some suppose. Plastics cements may make it possible to build without nails. Bathrooms and kitchens can be prefabricated more economically in factories where skilled workmen and mechanical facilities are available, then moved complete to the building site. These units require more skilled manipulation, more experienced men, to assemble on the job than any other rooms in a house. More time is wasted while the carpenter waits for the electrician, who waits for the plumber, who waits for his helper to run back to the shop for a forgotten part. Prefabrication avoids these stumbling methods of building, and plastics, more than anything else perhaps, make prefabrication possible because of the peculiar properties they lend to wood and other structural materials.

Don't expect an all-plastics house. That's silly, of course. But don't underestimate the part plastics will play in home construction and furnishing when the war is won. New plastics and new methods are naturals for refrigerators, cabinets, drawers, wardrobes, translucent or transparent doors and screens, storage space, and mechanical aids. Even walls and partitions in homes can be made of translucent plastics blocks. Or covered with plastics coatings that protect surfaces against cleaning compounds. These will come in direct proportion to economies effected in competition with older materials and more laborious manufacturing methods. Where no economies are found, plastics will not be used.

Innovations in Bonding Methods

Other things besides buildings are fastened together by various means. Almost everything manufactured requires some assembly and fastening devices to hold it together. Rivets, bolts, screws, thread, all have their weak points. They loosen, wear, rust or rot, and when they do, their service fails. Plastics might introduce innovations in fastening methods. Plastics sheets are stitched together by high frequency spot welding with nary a thread to rot nor a hole to leak. Shoe soles long have been cemented instead of stitched. When it rains, the water stops at the line of plastics cement. Even leather soles are impregnated with water-resistant plastic to prolong their life. One chemist of my acquaintance has worn for three months a pair of shoes with canvas soles impreg-



Aircraft wing sections molded from large sheets of mahogany veneers, bonded and impregnated with urea resin under pressure

P-38 experimental door section of two pieces of phenolic laminated canvas bonded at the center and edges with furane resin

nated with vinyl and cemented on with furane. This, during the rainy season, and there is no sign of wear, no leaks, and no "letting go".

Elasto-Plastics

Adhesives, and low pressure molding and laminating methods are but one tiny cloud on the plastics horizon. "Stretchy" types, called elastomers, line gasoline tanks made of anything from paper to rope. They have no fear of high octane fuels, even those containing toluol, xylol, or benzol, because they are immune to attack by these fluids and are cheap to build. They are molded and extruded like other plastics and are assigned to important war jobs. Just to name a few: hydraulic hose, fuel hose, Navy Diesel engine parts, Sperry Gyropilots, chemical warfare equipment. When there are some to spare, these elastomers will make good protective clothing for workers handling petroleum solvents and chemicals. Shoes, gloves, aprons and hats can be made.

Stretchy plastics, whether vinyl, vinyl chlorides, copolymers, or out-and-out synthetic rubber, have man-size industrial jobs ahead of them. Their ability to resist oxidation and to retain their elasticity on long exposure to sun and oils will dictate their usage. They may not make as good automobile tires as natural rubber. That remains to be seen. But their ability to stretch 200 percent without losing their elastic memory implies their value to many an engineer's mind.

Each Material Has Its Place

There are altogether too many promising materials and methods to cover in a hit-and-run review. Many will have to be left for another serving. Silicones can hardly be mentioned out loud except to say that they overcome one of the greatest weaknesses of many plastics—resistance to high heat. Ethyl cellulose made suitable canteens for soldiers when everybody said they could be made only of metal. This same plastic has turned out to be tough enough to take drop-hammer blows, day after day, on metal forming production lines where it is used as a punch die. And, among other things, it has laminated various fillers into boats and aircraft parts which take a lot of abuse. Since their beginning, plastics have been insulation superb. Since Pearl Harbor they have insulated almost every type of (*Continued on page* 104)

This glider tow rope is made of many strands of nylon filament. This plastic's tensile strength easily withstands the shock of take-offs

Experimental wing tip of resin bonded and impregnated wood veneers has excellent strength-weight ratio and high resistance to weathering

The angle and U-channel are made of ⅛" birch veneer, phenolic resin bonded. Trough channel is 1/16", of the same construction

This is the type of equipment used in vacuum forming plastics. The contact pin can be seen in the chamber

Limp and flexible from heating in an oven, the sheet is clamped between a Masonite ring and the pot

Evacuation of the pot draws the soft sheet into a parabolic shape which contacts the pin, shutting off the vacuum

NEW VACUUM TECHNIQUE

By Edmund Greene

Rohm & Haas Company

USE OF AIR PRESSURE DIFFERENTIALS SPEEDS MAKING 3-DIMENSIONAL PARTS

This 4.5 lb. cast aluminum housing cost $3.45, exclusive of dies

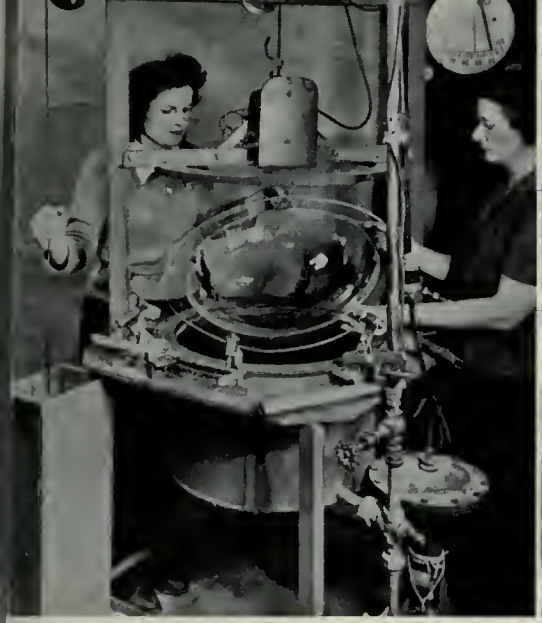
Formed of Plexiglas by the snap-back method, the housing costs $1.85 complete

PLASTICS have come of age during the last few years not only because of improvements in materials, but also because of improvements in transforming those materials into finished products. It was only a few years ago, for example, that an 8-oz. injection molding press was a novelty; now presses of three and four times that capacity are in service and much larger ones are promised for the future.

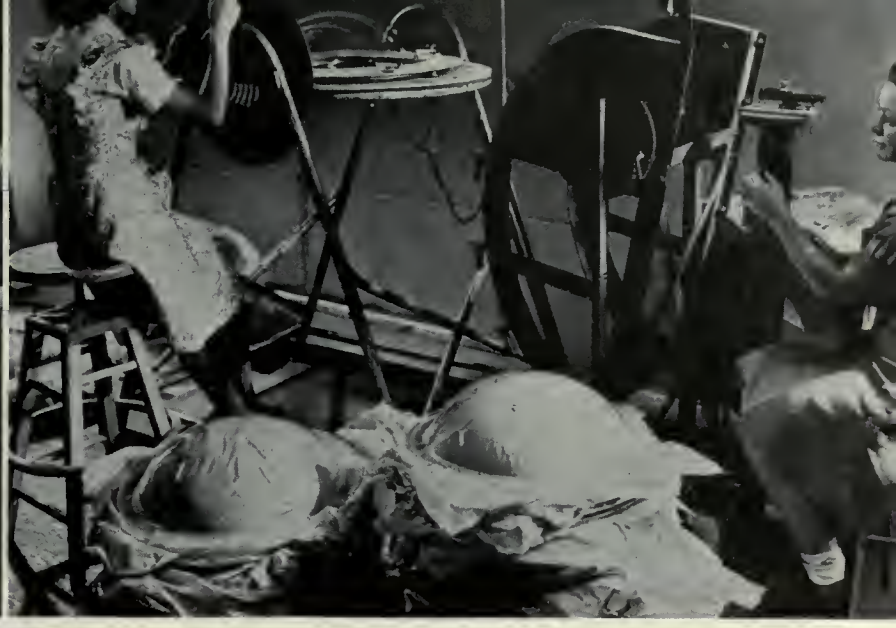
Similarly, the fabrication of plastic sheets was somewhat in the trinket stage even as late as 1936. Now large aircraft parts, meeting high optical as well as mechanical standards, are in mass production. True, plastics fabrication has not yet reached the stage of development of the metal-working industry, but rapid progress has been made particularly during the war years.

One major step forward has been the use of air pressure differentials in the forming of three-dimensional sections from flat sheet. These methods, developed in the Rohm & Haas Company plant and introduced into the plants of their sub-contractors, have been the key to the successful fabrication of thousands of Plexiglas (methyl methacrylate) turrets, astrodomes and other aircraft parts. Moreover, they hold real significance for the future of fabricated plastics, for they extend the range of shapes which can be fabricated efficiently and economically from acrylic sheets.

Step by step, fabricating methods advance and when a great stride is made in fabricating technique, plastics materials fit more products. This new air pressure differ-



After a few minutes' cooling, speeded by the electric fan, the astrodome has set permanently to a spherical section



The astrodomes are tested with a surveyors' transit sighted on a target 50 ft. away. If the introduction of an astrodome, in any one of 32 positions, causes an error of more than 4/5", the dome is rejected

SIMPLIFIES SHEET FORMING

ential technique for thermoplastics paves the way for fast, low cost housing and forms of sizes comparable to the products of huge metal stamping presses.

At the outset of World War II, the standard procedure for the forming of large three-dimensional sections consisted of heating a thermoplastic sheet such as Plexiglas in an oven to a temperature of 220-300°F. After removal from the oven, it was allowed to cool for a few seconds to chill and harden the surface slightly. Then a ring of men—numbering as many as 12 in some cases—literally stretched the still soft sheet over a male form. This stretch-forming method produced parts which were optically satisfactory but the method required a number of skilled men and there was always some danger of deforming the smooth polished surface of the sheet in stretching it over the cloth covered form. Attempts to mechanize the process to approach the stamping and swaging methods of the metal industry were not too successful because, even with polished dies, mold marks, or "mark-off", were often excessive.

Vacuum Forming

The use of male and female forms was not entirely satisfactory, especially where optical properties were important, because both surfaces of the soft acrylic sheet came in contact with molds and the chances for mark-off were therefore doubled.

When air-pressure differentials do the work of forming, all of these objections are answered. Time and particularly manpower are cut. Stretching in the sheet is far more uniform than a ring of men can usually obtain. Most important, contact between the sheet and the form is either entirely eliminated or markedly reduced and optical distortion of the surface is therefore held to a minimum.

An excellent case in point is the fabrication of Army and Navy navigator's astrodomes. For this part and for most air-forming, we have preferred vacuum-forming to

Installed in an airplane, the Plexiglas astrodome protects the navigator and provides clear sighting

pressure blowing; first because of the safety factor, and second to avoid the danger of stray drafts of cool air hardening the sheet unequally during forming.

The astrodome is a shallow section of a sphere about 6" by 22" in diameter. The optical tolerances of this part are extremely critical for the aerial navigator sights his sextant through the acrylic form. A deviation in these observations of 1° is an error of almost 70 miles on the earth's surface. These 70 miles could be disastrous to

Two different shaped vacuum pots and the parts that were produced by them

American bombers over enemy territory or over the ocean.

Especially selected Plexiglas sheets are heated in an oven to approximately 250°F. The soft sheet is removed and quickly laid over the top of a vacuum pot. A ring of Masonite die-stock is lowered to clamp the edges of the sheet, and the vacuum valve opened. As the sheet is drawn to the required 6" depth, it touches a contact point which automatically shuts the vacuum valve. If, in cooling, the sheet tends to draw away from the contact point, the vacuum valve is again opened. Thus the depth of draw is automatically controlled within close tolerances. In a matter of minutes, the part is cool enough to be removed. Because the operation is mechanized and even the light clamping ring counter-balanced, a team of two girls can—and has—turned out literally thousands of these parts, each meeting extremely close optical tolerances.

In the inspection of these parts, a surveyor's transit is aimed at a target 50 ft. away. If the introduction astrodome in any one of 32 positions introduces an error of more than 4/5" in the transit sighting, the dome must be rejected.

Since, in the case of astrodomes, the opening in the vacuum pot is circular, the astrodome itself is a section of a sphere even though it is formed with a shallow draw. This effect is even more apparent in the case of parts with deeper draws. Since most of the first stretch comes in the center of the sheet, this section thins out first and therefore hardens first because of the more rapid heat dissipation. The thicker areas around the sides and circumference continue to be drawn since they are still soft and plastic. Thus a bulging or fishbowl shape is produced. Even if the opening of the vacuum pot is square or triangular, the Plexiglas tends toward a spherical shape since a sphere has the smallest skin for any given volume. The same basic law would apply in the case of blowing soap films through different designs of openings. The resultant shapes are often called "surface tension shapes".

It is possible to increase the number of shapes which can be fabricated by vacuum-forming by altering the shape of the pot opening in two dimensions. Varying the opening of the part in the second dimension is sometimes very desirable since it materially reduces the inevitable thinning out of the sheet. This thinning out, incidentally, is not always undesirable either optically or mechanically. In the case of the astrodome, for example, it does not affect the accuracy of the navigator's reading or it can be compensated for in a sighting mechanism. Also, surface tension shapes are usually stronger as well as more desirable aerodynamically. Air pressure differential forming offers an advantage over stretch-forming in that the thinning out is relatively uniform.

Where the desired part varies radically from a true surface tension shape, it is often possible to form the part by the so-called snap-back method. This method is based on the tendency of heated Plexiglas to return to its original flat sheet form, a tendency known as "elastic or plastic memory".

"Snap-back" Forming

Snap-back forming is a variant of vacuum-forming and is also done in a vacuum pot. After the heated sheet is drawn into the pot, a wood or plaster male form, which reproduces the inside contour of the desired part, is low-

Snap-back forming differs slightly from vacuum forming. In making a turret, operator at left rolls a sheet into the oven, while at the right the soft sheet is being stretched across the pot

ered into the bubble formed by the Plexiglas sheet. Since the sheet is still hot, it will have a tendency to resume its flat sheet form. Therefore, as the vacuum is gradually released, the Plexiglas "snaps back" slowly against the form. This stage of the operation requires care to reduce to a minimum any movement of the soft sheet relative to the form. It could be made automatic, however.

Fromed by Air

Here again the work of forming is done by air. Instead of being stretched across the form, the Plexiglas is stretched before it comes in contact with the form. The form is, of course, constructed with sufficient draft to permit easy removal of the piece.

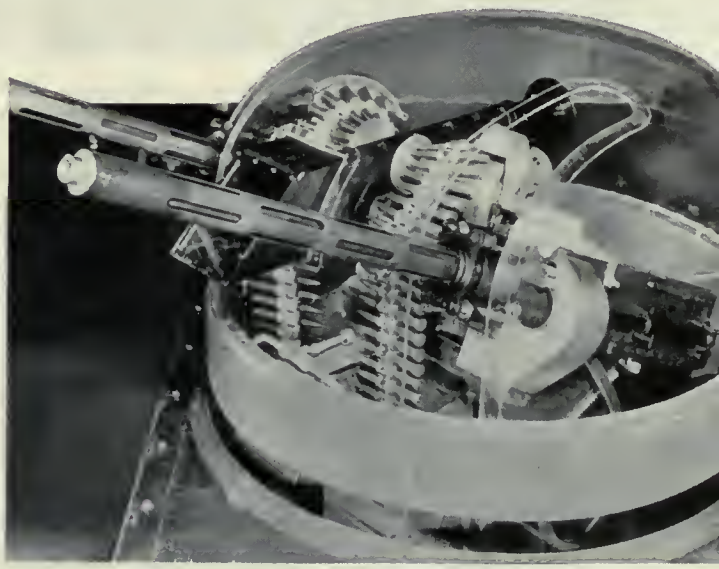
While snap-back forming has been used for many different shapes, including the familiar power turret mounted on the back of most American bombers, it also imposes certain contour limitations. The heated sheet will not snap back into reverse curves and will not follow rapid changes of contour very accurately. Nevertheless, it is possible to maintain closer contour tolerances in snap-back forming than is possible in vacuum-forming—$\pm 1/8''$ approximately has been obtained as opposed to $\pm 1/4''$ or even $\pm 1/2''$ for some vacuum-formed parts made by careful production methods.

By variations in the vacuum and snap-back methods, it is also possible to maintain closer control of the thinning out of a given section during forming. For example, if additional thickness is required at the apex of the deeply drawn sections, it is possible, in snap-back forming, to allow the form to come in contact with the Plexiglas as it is being drawn down. The form will cool the sheet in that area and reduce the thinning out of that section.

In other cases, it is possible to cool parts of the sheet by means of air blasts, but this practice cannot be recommended since it may well set up undesirable strains in the formed part. With skilled operators it is also possible to allow a certain amount of the material to slip in through the clamping rings during drawing. Still another method consists of differential heating of the Plexiglas blank—in other words, by covering certain sections of the sheet while it is in the oven. These sections will not be softened and hence not stretched or thinned out in the forming operation.

Inherent in both the vacuum and snap-back methods is an integral flange at least $3/4''$ wide where the part has been clamped to the vacuum pot. In the installation of such parts, this flange provides a strong and simple method of mounting. The contour of these flanges can be held to fairly close tolerance regardless of the tolerance maintained on the rest of the part. Very often it is desirable to specify tolerances only for the flange allowing greater leeway in the contour of the rest of the section.

Since these methods have been in use in the Rohm & Haas Company plant, their possibilities in the manufacture of aircraft sections have been thoroughly explored. However, in forming other Plexiglas parts ranging from light shields to business machine housings and bottles to decorative globes, they should prove even more useful. The obvious economies they offer will permit plastics to be used for a host of such medium and large three-dimensional parts which ought not be molded because of the limitations of press capacity or cost of molds and for which older forming methods were slow and costly. END



The turret as it is installed on a North American Mitchell bomber

The heated sheet is wiped as it is drawn into the pot, then the mold is lowered to reproduce the inside contour. The view at the right shows the formed turret being removed from the pot

1 Coating: Three coats of a mold coating compound, and one of liquid wax are brushed on the mold

2 Pouring: Careful pouring of the batch into the mold is necessary to avoid the trapping of air bubbles

Casting Heavy-Duty PRODUCTION TOOLS

By Don Dreher
President, Adhere, Incorporated

"TOOLITE," A THERMOSETTING PLASTIC, CONTRIBUTES TO THE WAR EFFORT IN FORMING AND STRETCHING AIRCRAFT PARTS

TECHNICAL advancement in the use of cast phenolics for tool mounts and metal forming tools has made important strides with the development of materials that have unusually favorable characteristics. Plastics form blocks and other tools were first used because of a critical shortage of strategic metals, their development taking place principally in aircraft plants, where large sections of aluminum alloys are formed. Since schedules in aircraft plants did not call for large numbers of such parts or the rapid production demanded by other industries such as automobiles, plastics dies made acceptable aircraft production utilization.

Early types of plastics tools had relatively little to recommend them except availability and ease of production. As materials improved, however, these tools gradually equaled or excelled their metal rivals in overall cost and performance.

Today, plastics have reached the point where they are no longer regarded as substitute materials. In less than two years, cast resins have gained so strong a position that some production men predict their use for a majority of metal forming operations on postwar aircraft, as well as a wide range of applications throughout metal forming industries. Plastics have attained this position because intensive research has created and developed properties and characteristics to fit them exactly into specific services. Rather than a hit-or-miss approach or the use of resin as a "cure-all", present plastics technicians recognize limi-

3 Curing: Filled mold is placed in a temperature-controlled oven for a predetermined period of time

4 Removal: Once cured, female castings are removed from the mold immediately; male castings shrink in the mold

tations as well as advantages of these materials and use them on a scientifically controlled basis.

Much of the recent development in aircraft tools and tooling has been based on Toolite, a thermosetting phenolic resin developed by Adhere, Inc., of Los Angeles. The tooling and manufacturing research divisions of Consolidated Vultee Aircraft Corp. were leaders in research with this material, which is now in use by many leading airplane manufacturers.

One difficulty with former use of casting resins was that each batch had to be mixed with the appropriate filler, an operation that always involved possibilities of error. Toolite is ready mixed in liquid form, to which only the catalyst need be added, assuring uniformity from one batch to the next.

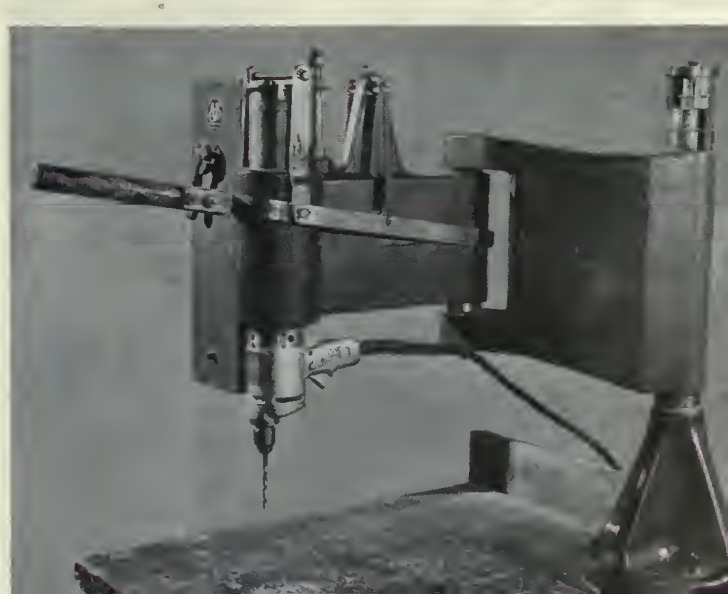
Tools Have Great Strength

Tools made of this material have a high compressive, flexural and impact strength. Laboratory tests have shown compressive strengths of Toolite above 13,000 psi, with flexural strength of 3270 psi and impact strength of .25 ft. Weight after hardening is 78.59 per cu ft, weight which makes possible tools that are easy to handle, such as router blocks and radial drills.

After curing, these plastics tools show no apparent absorption of water, oil or cutting compound. There is no softening point as Toolite chars above 400°F. This material is a non-conductor of electricity, and is resistant to alkaline solutions, except for surface color. Furthermore, solvents or commercial acid solutions have no deleterious effect on it.

Although plastics tools are making excellent records in production service, workers must be educated against their abuse. Aircraft manufacturers report a tendency on the part of employees to test the new material with hammers

5 Finished: This tool arm of Toolite has been provided with a metal insert for attachment to the radial drill shown below. A number of these unusual applications are in operation at Consolidated Vultee's San Diego plant



This radial drill finds its structural strength in thermosetting plastic castings. The head housing, radial arm, and swivel mounting are cast of Toolite. The assembly is light in weight and unusually strong. Acid vats also are cast of the same plastic material

Toolite can be machined by conventional woodworking tools. Here form blocks are being cut (above) and shaped (below)

or by dropping it on concrete floors. Part of the use of these tools must be education of the workers that these are precision tools just as much as though they were made of metal.

Plastic material was used in structural parts for the first time in radial drills built by Consolidated Vultee's San Diego plant; these parts measure 18" by 24", 12" by 22". There also is a 14" high stand.

Instead of being cast in a split mold, parts for the radial drill are now being cast in one piece with a core of air filled Toolite which remains inside the completed mold.

Among the more generally used tools in the aircraft industry are compound dies for the hydropress. Where it was formerly necessary to make a pattern, a sand mold and a casting that had to be machined, such dies may now be cast of Toolite with virtually no finishing process required. Used with the thermoplastic "Plastalloy" for a punch, Toolite has been found suitable for female dies and pressure pads for double action hydropress operations. One part now being made with this tool is a window frame of .050 gauge, 24S-O with a hold down area of 20" by 30", with 150 tons on the pressure pad and 300 tons on the punch and female die.

Stretch press blocks made of plastics are lighter than concrete forms and have the additional advantage of using a water soluble oil for quick cleaning. In one plant, more than 1000 pieces have been formed under the same plastic block on a stretch press.

In addition, Toolite dies need no machining, scraping and other finishing processes. They thus free expensive machine tools and skilled workmen, who would otherwise be engaged in the finishing of metal tools.

Conventional Tools Used

Conventional woodworking tools can be used, or the Toolite dies can be cast to conform exactly to the contours of molds. Simple form blocks are easily cut out of cast slabs, which are customarily made up to 3" by 5", and ½" to 5" thick. The material will pick up any finish on the mold, so that wood grains, rough, or glass-smooth surfaces may be obtained as desired.

Equipment normally required for the operation of a successful tooling department includes standard cake mixers of 80 qt capacity, 20-qt and 80-qt tin lined mixing bowls and 80-gal storage tank with motor driven agitator, cleaning and rinsing bowls, thermostatically controlled, electric ovens of ample size to make the largest casting desired, and necessary controls, steam and water lines, etc.

In the Toolite casting process, which is easily done by unskilled workers so long as directions are followed, the first step is preparation of the mold, which may be of wood, Toolite or another plastic. Molds must be designed with generous radii at corners and with suitable allowance for shrinkage. The inside surface of the plastic mold is given three coats of mold coating compound and one coat of liquid wax. Liquid Toolite is thoroughly stirred in the storage tank and the correct amount of catalyst is added to the batch to be poured. This is now mixed and after standing, the batch is again stirred before pouring into the mold.

The liquid resin is poured carefully so as to strike the lowest part of the mold so that no air bubbles are trapped. Castings poured under vacuum have shown extraordinarily high density and strength, but so far this method has not been considered necessary or practical in commercial operations.

Metal inserts for reinforcement, anchoring, clamping, locating, etc., may be installed quickly and permanently. The filled mold is placed in the oven at 150°F for four to eight hours, depending on its size and the mold material. Once caked, female castings are immediately removed, but male castings are allowed to shrink first, then removed.

Toolite dies are easily cleaned with denatured alcohol or a hot solution of any good alkaline cleaner. They can be quickly and easily repaired if necessary, and old dies can be reclaimed for use as filler.

Standard plastics tooling departments are now being established in many sections of the country and it is reasonable to expect that this method of tool production will find broader use in many divisions of industry. END

Tonettes molded by Elmer E. Mills Corp. for Chicago Musical Instrument Company *Ocarinas molded by Plastics, Inc., for Fred Gretsch Manufacturing Company*

G.I. music-makers

OCARINAS AND TONETTES made of Tenite furnish the jive for many a jam session held in foxholes, canteens behind the lines, and on troop convoys. These easy-to-play, pocket-size instruments, with instructions and music, are issued by the Army to troops now serving overseas.

An extremely tough plastic, Tenite withstands the banging around and rough-housing to which these musical instruments are subjected. Tenite is shatterproof and dirt resistant. It is injection-molded at the fastest speeds ever attained with plastics to produce tonettes, ocarinas, bugles, whistles, and other products for the U. S. Army. Further information about Tenite and its adaptability to your product will be supplied upon request. Write TENNESSEE EASTMAN CORPORATION (Subsidiary of the Eastman Kodak Company), KINGSPORT, TENNESSEE.

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TENITE

AN EASTMAN PLASTIC

A Designer Appraises Plastics

By Jean O. Reinecke
Barnes & Reinecke

Specification of plastics must consider properties as well as eye-appeal

ALL materials should be chosen for what they will do, for their fit to the problem and to the job. Plastics are no exception. Starry-eyed Sunday supplements to the contrary, plastics are earthbound basic materials used because they meet hard-headed requirements of strength, weight, flexibility, transparency, dielectric properties, heat resistance, chemical, corrosion, abrasion and shock resistance, because they offer unique opportunities for speedy labor and money saving manufacture.

Plastics should not—need not—be used for "stunt" performance. It may be part of their fit to the job that they have appeal for the eye and the sense of touch. Sales are stimulated for such reasons which are not the major assets of plastics. People may plan to use plastics for their products because of glamour stories which proclaim them the answer to everything in a dream future world. But over 80% of all plastics produced today go to war, in planes that have hundreds of plastic parts and must withstand temperature changes from 130° on the ground to 30° below zero in a matter of moments, in battleships which use thousands of plastic items, in projectiles engineered to precision dimensions.

Plastics' smash delivery on today's front lines of war and wartime industry state their case and chart their course for the future. It is our intention to increase sales for our clients, and plastics used as a styling feature of a product alone often increases sales, but we choose plastics also for their value in engineering and to secure for our clients the increased profits resulting from manufacturing advances.

Everything else being equal, the designer might choose a plastic for a certain product because of its color, and in plastics he has color at its eye and customer catching best. But in plastics he also has color which saves the manufacturer the extra processes of surface finishing and coating—the plastic has the color all the way through and it won't wear off or chip off. He might choose plastic for a knob because it feels good in the hand but it is also a one piece, one operation, cost saving job. If he wishes through his design to increase structural strength, with a

Evolution of Burton Mfg. Co. dental lamp: (Left) The old, well known, green glass shade type. (Right) Redesigned with phenolic shade, louvres, handle, tuner and translucent visor. (Below) Second redesign with phenolic parts expanded to focusing light and fluorescent lamp shades and handle

Above, left to right: Four successive stages in the redesign of the Dunham radiator valve handles—Original, heavy, seven-piece metal assembly; first model; second model; and final model of simplified, two-piece assembly, light in weight

Below—Dunham valve handle redesigned for phenolic molding with savings in weight and cost

plastic, reinforcements such as ribs, flutings and bosses may be incorporated in the mold design.

The fact that with plastics complicated shapes may be formed in one operation has both advantages in appearance and in the elimination of assembly and finishing operations. The product from the mold may be shiny or dull, whichever is desired, it may be smooth, without sharp edges, and it may assume the curved flowing lines of popular modern design very naturally. The designer is offered infinite scope, for his design form is not so limited to raw material sizes and shapes. And if the product is to be a counter display, as one of our design problems was, where sixteen partitions were needed—they can be easily included with no assembly cost at all.

The large volume production of radio cabinets make them a good example. Plastics make possible the infinite variety of shapes they must have. With so many manufacturers making an enormous number of new models each year, the price is kept low through fabricating the cabinets in plastics since other materials require complex cutting, shaping, assembly and finishing. The cabinets have color possibility and rich finish in plastics. Plastics solve the problem of smooth pleasant feeling knobs. Since plastic molding of radio cabinets is much less expensive than any other method of producing them, these cabinets are priced as well as styled for volume sales.

Sometimes an item is so small that the manufacturer doesn't think of it as a subject for redesign in plastics, yet we can cite as an example a valve redesigned in plastics to effect enormous savings in manufacturing efficiency. It was the valve used on radiators for which we were designing new housings. We were able, through redesign, to reduce its assembly to two pieces instead of the seven formerly required. The new fabrication, with the exception of drilling a hole for a screw, required only one operation instead of several, some of them difficult such as broaching, drilling and threading. The new knob, of phenol-formaldehyde was heat resistant, needed no plating as the old one did. Since it was necessary to allow for access to the screw we were able to specify molding of the screw cover and name plate in one piece.

We reached for color first of all in the design of the Dazey Super-Juicer and we liked the novelty of plastic

(*Continued on page* 102)

Left—"Ducky Blanket Clips"—popular, useful, gift items molded of cellulose acetate

Right—Burton Mfg. Co., dental spot lighting housing designed to be molded of phenolic in same dies used for X-ray film viewer

Plastics Parts in

WAR RADIO

By Cyrus T. Read

Engineering Dept., The Hallicrafters Co.

RADIO INDUSTRY — ONE OF LARGEST AND OLDEST USERS OF PLASTICS — HAS ADDED MORE NEW USES

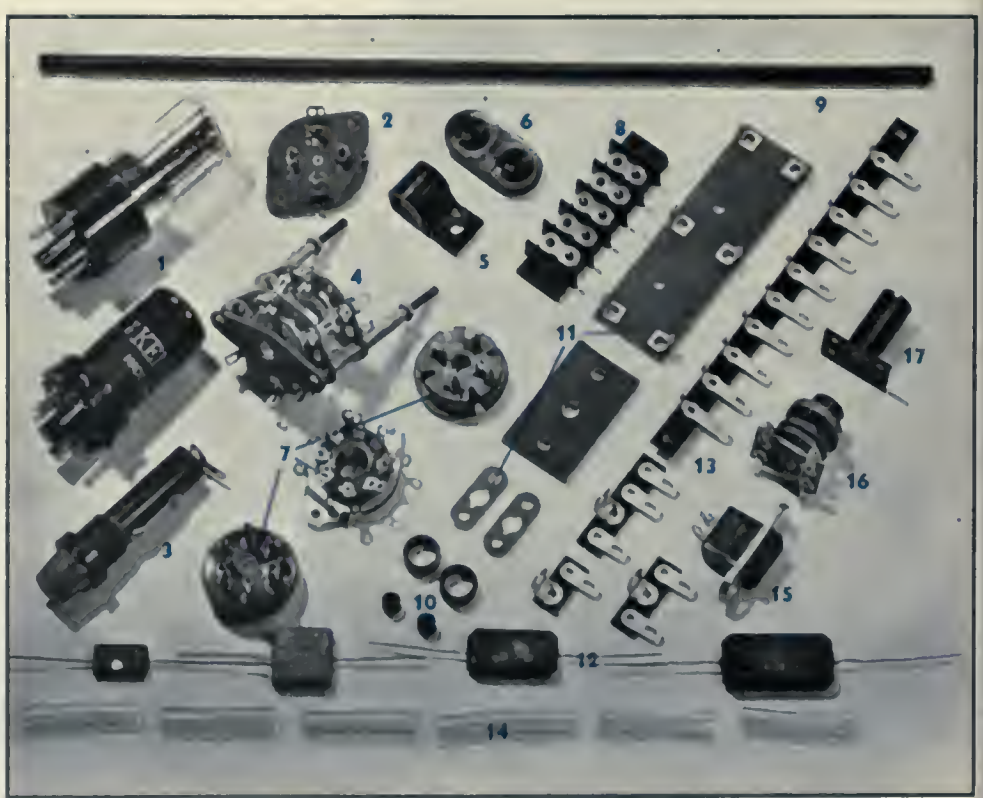
Army receiver showing exterior plastics parts. Phenolics are used to mold the three panel escutcheons and all control knobs, vinyl sheeting for carrier level and meter dials, and translucent phenolic sheeting for tuning dial

THE radio industry, among the first major users of plastics, is today becoming more than ever dependent upon this most modern of raw materials. The use of plastics, both as a dielectric and for structural components of radio equipment, has become such an integral part of radio design that men in the industry are apt to take it for granted. Only those who remember the early days of "wireless" can appreciate the extent to which the development of plastics has changed the construction of radio equipment.

The designers of early radio apparatus followed the practices of the electrical industry and made use of materials which were then available. Power switch boards of that period (the early 1900's) were commonly large slabs of marble and it was not unusual to find a high voltage spark transmitter mounted on such a support. The combination of polished brass and gleaming varicolored marble gave a most attractive appearance. The fact that the streaks of color in the marble often indicated metallic deposits and that the whole thing was usually more or less a short circuit did not seem to matter. Smaller pieces of equipment, such as crystal detectors, were often mounted on marble bases also. The effects were not too serious, however, as much of that early equipment was inherently in-

RADIO INTERIOR PLASTICS PARTS:

1—Vacuum tubes with mica-filled phenolic bases
2—Punched linen base phenolic tube socket
3—Molded phenolic fuse assembly
4—Switch assembly, paper base phenolic wafers
5—Molded phenolic cable clamp
6—Molded phenolic terminal bushings
7—Molded phenolic tube sockets
8—Molded phenolic terminal strip
9—Molded phenolic extension shaft for switches and condensers
10—Grommets of molded phenolic
11—Cut and drilled supports, paper base phenolic
12—Fixed condensers molded in phenolic covers
13—Terminal strips and tie lugs, punched paper base phenolic
14—Vinyl tubing
15—Molded phenolic power line socket
16—Radio frequency coil, cast phenolic form, linen base phenolic end plate
17—Newest radio frequency coil form cast in one piece with adjustable core for RF coil of powdered iron in phenolic resin binder



efficient and a few additional losses made no difference. Less pretentious pieces customarily used varnished wood for insulation.

As the art progressed, it became evident that better insulating materials would be necessary. The first real improvement was the adoption of hard rubber. This material came into rather wide use in the more expensive pieces of equipment and is occasionally used to this day because of its low loss characteristics. In any discussion of an insulating material for use in the radio field, it must be understood that its dielectric constant, its power loss at high frequencies, and its mechanical properties are all prime considerations. Hard rubber was used in many forms: as panels upon which to mount the various radio components, as molded insulators, as tubing on which to wind inductance coils, and in numerous other ways. Its chief disadvantage was lack of mechanical strength and deterioration with age and exposure to ozone. The high sulphur content also proved injurious to metal parts in enclosed spaces.

Cheaper equipment made use of "pressed fibre," a sort of heavy-duty cardboard. This material had a mechanical advantage over rubber but was very inferior as an insulator, chiefly because of its tendency to absorb moisture.

Another molded material appeared in the early days of radio under the trade name "Electrose." This was a hard, mottled brown substance and was usually cast into whatever form was needed—stand-off insulators, feed-through bushings and the like. It was more weather-proof than most of the other insulating materials and had greater mechanical strength than the porcelain or glass insulators available at that time. It could, however, be chipped and after several years' service, began to deteriorate.

All of these substances were before the advent of phenolics.

About the year 1920, a new insulating material became available to designers of radio equipment. It had the appearance of hard rubber and was, to some extent, the object of suspicion as being merely a substitute. The word soon got around, however, that sheet Bakelite would do everything hard rubber would do and, in addition, would keep on doing it. It had mechanical strength, good dielectric qualities and could be easily worked. Its higher loss factor was not generally understood and was not too serious at the comparatively low frequencies in use.

Low Loss and Dielectric Developments

With the expansion in the radio industry caused by the introduction of broadcasting, many new manufacturing techniques were tried. It became evident that some faster means of production would have to be adopted in the making of small parts such as tube sockets. Accordingly, radio manufacturers looked around for materials which could be molded. One early substance was apparently made of shellac and lamp black. It was easily molded and had a beautiful appearance but, unfortunately, was so sadly lacking in mechanical strength that it soon became known as "molded mud."

The introduction of molded Bakelite parts definitely set the trend for future design. For a time this new technique so intrigued the designers of radio equipment that they attempted to mold almost everything and it was not unusual to find a receiver with large bulbous variometers, elaborately molded variable condensers and other components concealed within fantastic appearing housings all mounted in the open where the customer could admire the beautiful brown or black Bakelite. Unfortunately, the inclusion of so much dielectric with a comparatively high loss factor merely decreased the efficiency of these receivers.

Ribbed spheroid coil form, 4" by 5", for U. S. Army radio, molded of low loss Bakelite phenolic by the American Insulator Co., New Freedom, Penna.

About the year 1924, the "low-loss" exponents began to make themselves heard and the design of equipment went to the other extreme. Designers vied with one another in the effort to get along with as little insulating material as possible and some of the inductance coils of that period were apparently supported by remote control!

After the first excitement over the discovery that the efficiency of radio equipment could be greatly improved by keeping dielectrics with a high loss factor out of high frequency electric fields, the industry took a more moderate course and began a search for insulating materials of better electrical characteristics. The improvement has been steady and sure with the result that today there are many plastics available which meet the requirements of low loss factor, good dielectric constant and mechanical strength.

An excellent example of the use of plastics in modern radio equipment may be found in the Model SX-28 communications receiver built by the Hallicrafters Company, large exclusive manufacturers of short-wave radio communications equipment. A communications receiver, as distinguished from an ordinary home radio, is designed primarily for use in point-to-point service and incorporates many features not found in the ordinary radio set. The SX-28 is in world-wide use by our armed forces in this type of work.

Newest Applications of New Materials

At first glance, it might appear that there are very few opportunities to use plastics in a receiver such as this but a careful analysis will show how indispensable these substances have become. Taking the more obvious applications first—the control knobs, panel escutcheons and meter cases are all of molded Bakelite. This is the standard grade Bakelite and is used primarily for mechanical reasons, loss factor not being a consideration. The tube sockets and bases of the vacuum tubes are made of mica-filled phenolic. Mica-filled phenolic is usually weaker than general purpose unless a fibrous filler is used with it.

(Continued on page 113)

SHATTER-RESISTANT GAGES

By F. W. Dwyer
President, F. W. Dwyer Manufacturing Company

The butyrate tubing's resistance to breakage is emphasized in this demonstration of its flexural strength

Cut from a Lucite block, this manometer also has plastics parts

THE presence of mercury in an ordnance plant, even if sealed in a sturdy glass gage, is enough to keep a chemist aware of the hazard. Should it be shattered from the impact of a fall or a blow, the free mercury could cause some dangerous contamination. But no one need step cautiously around the newer mercury gages utilizing plastics tubing. The mercury is safely confined.

Even beyond the extreme instances when extra safety precautions depend upon the shatter resistant characteristics of plastics are the more ordinary advantages of this quality. Gages suitable for measuring air pressure are located or carried in many tight places; in mines, underground chambers and in the bowels of ships. In a maze of machinery and catwalks a tool laden worker might accidentally smash a glass instrument. To the cost of its replacement must be added the serious loss of man hours until a duplicate can be secured.

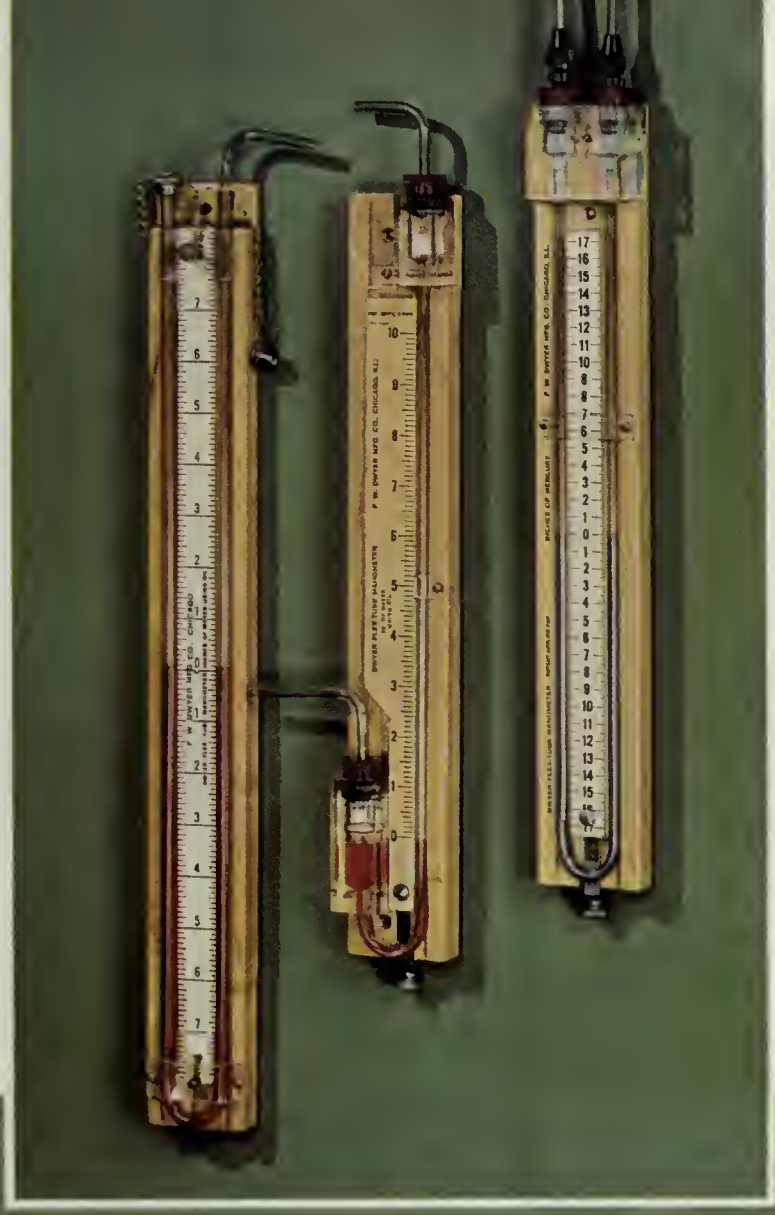
But plastics gages offer many more decisive advantages over any other material practical for the transparent tubing in pressure recording instruments. Besides being shatter resistant, gages made of plastics are uncommonly easy to handle. Couplings can be squeezed together and separated with a simple twist of the wrist. Operations are speeded with the press-in tapered connectors that eliminate both laborious nut-twisting and possible thread-stripping.

Add to plastics' credit that it can be easily fabricated, that it can be bored and reamed to hold a diameter more constant than is possible with drawn or molded glass tubing, that it is flexible enough to be adapted to almost any fitting by the user, and you will realize how far superior plastics are for fabricating pressure instruments. Besides having conserved critical metals, the use of plastics eliminates the origin of static sparks in highly combustible atmospheres and made possible completely non-magnetic instruments for use with sensitive magnetometers. It does not attract coating from pigmented liquids such as are used in manometers so that it keeps its transparency.

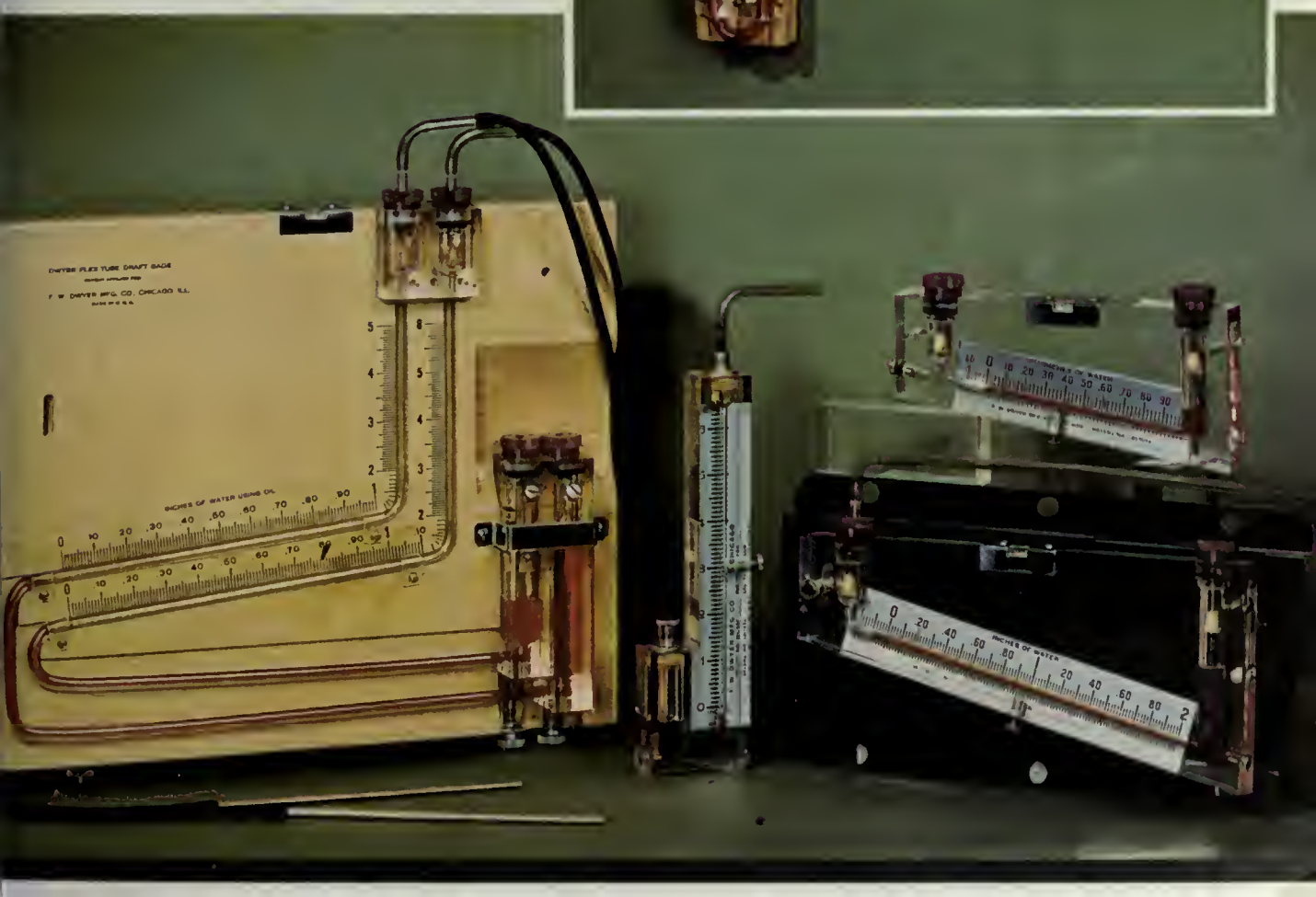
(Continued on page 100)

Cellulose-acetate-butyrate (Tenite II) is used for the tubes of these manometers, and the reservoir blocks at the ends are produced in acrylic (Lucite)

LIGHT IN WEIGHT, EASY TO HANDLE, THESE PLASTIC GAGES INSURE A DEGREE OF PLANT SAFETY



Plastics are particularly adaptable to the precision construction demanded in complex gages such as these



PLASTIC LENSES
Light Front-Line Airports

By R. E. Blanchard

Stimson AGA Plastics

LIGHTING IMPROVED, BREAKAGE REDUCED, ASSEMBLY SIMPLIFIED

THE transparency and strength of methyl methacrylate which in large part has fostered its extensive adaptation for windshields and nose sections of our war planes have recently made possible its use for still another important aviation installation—this time for the lenses of portable field lighting sets. They are already making an important contribution to the war effort. Moreover, the amazing success and utility of this installation assures an ever-widening commercial use of acrylic along similar lines after the war.

The acrylic plastic selected for the lens has a light transmission of up to 95% compared to 88% for top quality *pressed* glass. With the simple, fast procedure of molding, light transmission is prismatically brought out comparable to that of fine, precision grinding of crystal glass.

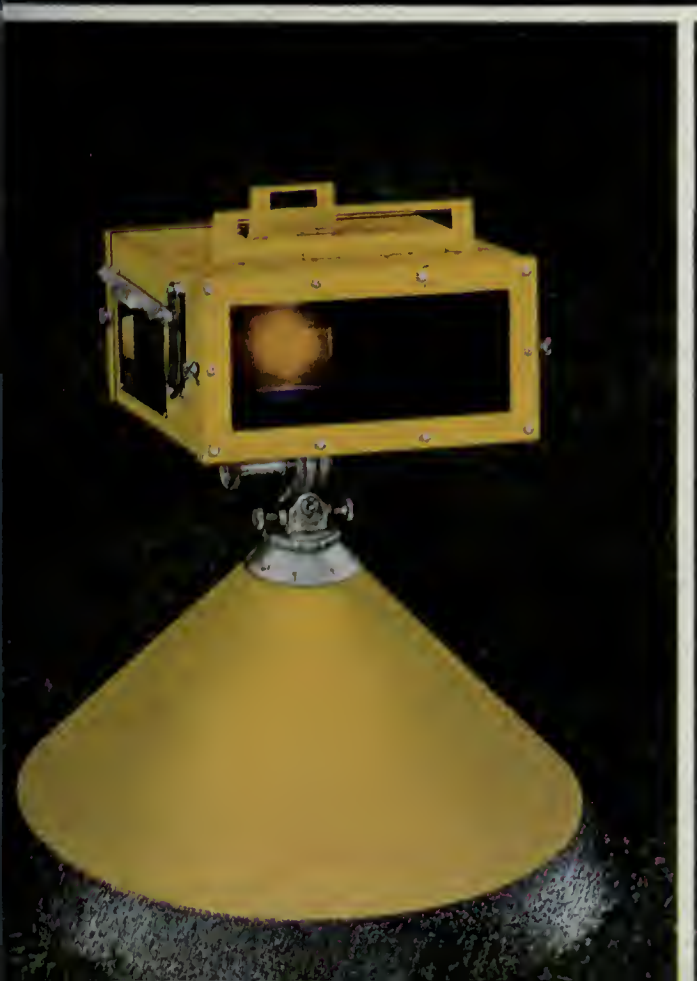
In these properties that fulfill the signal visibility to pilots traveling at great speed and at extreme distances, it is easy to see that acrylic lenses are destined for wide use in signal lighting. Smaller traffic lights visible at greater distances will be possible with smaller bulbs consuming less power, smaller, lighter metal standards to contain them, less maintenance cost because the lenses are non-shatterable. With the principle used for the airport lenses, three red, yellow and green stoplight lenses could be molded as one lens. The advantages should offset the lower initial cost of conventional lenses.

Weight Saving—Power Conservation

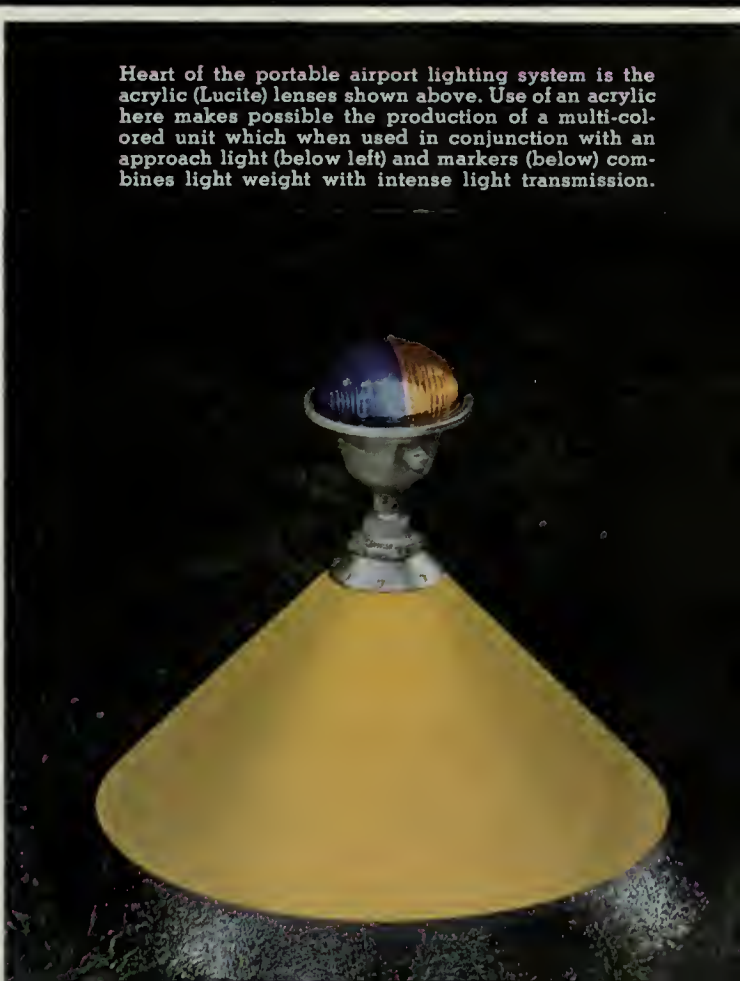
For portable airport lighting sets, the lenses are molded of Lucite by Stimson AGA Plastics, Chicago, and assembled into the finished lighting unit by Adams & Westlake, Elkhart, Indiana, Lights, Incorporated, Alhambra, California, and American Gas Accumulator, Elizabeth, New Jersey. The lenses feature not only excellent transmission of light, but also a 50% saving of weight as well as reduced bulk—two important factors when it is understood that a great deal of this equipment is ferried to the front line areas in cargo aircraft. Actually, the thirty-one lens units in the set weigh less than six pounds.

But weight saving is not the only economy. The optical property of unusually high light transmission permits the

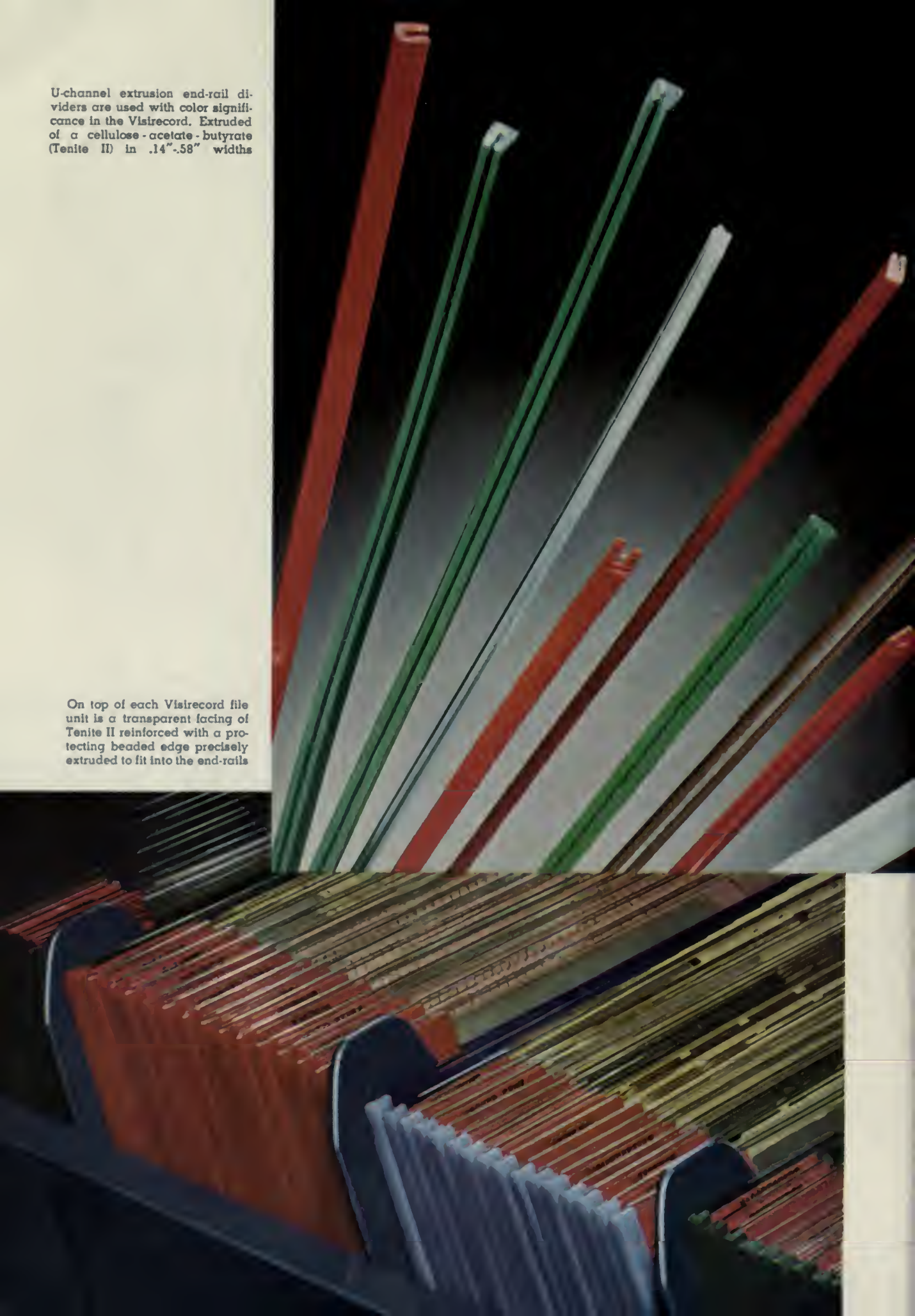
(*Continued on page* 110)



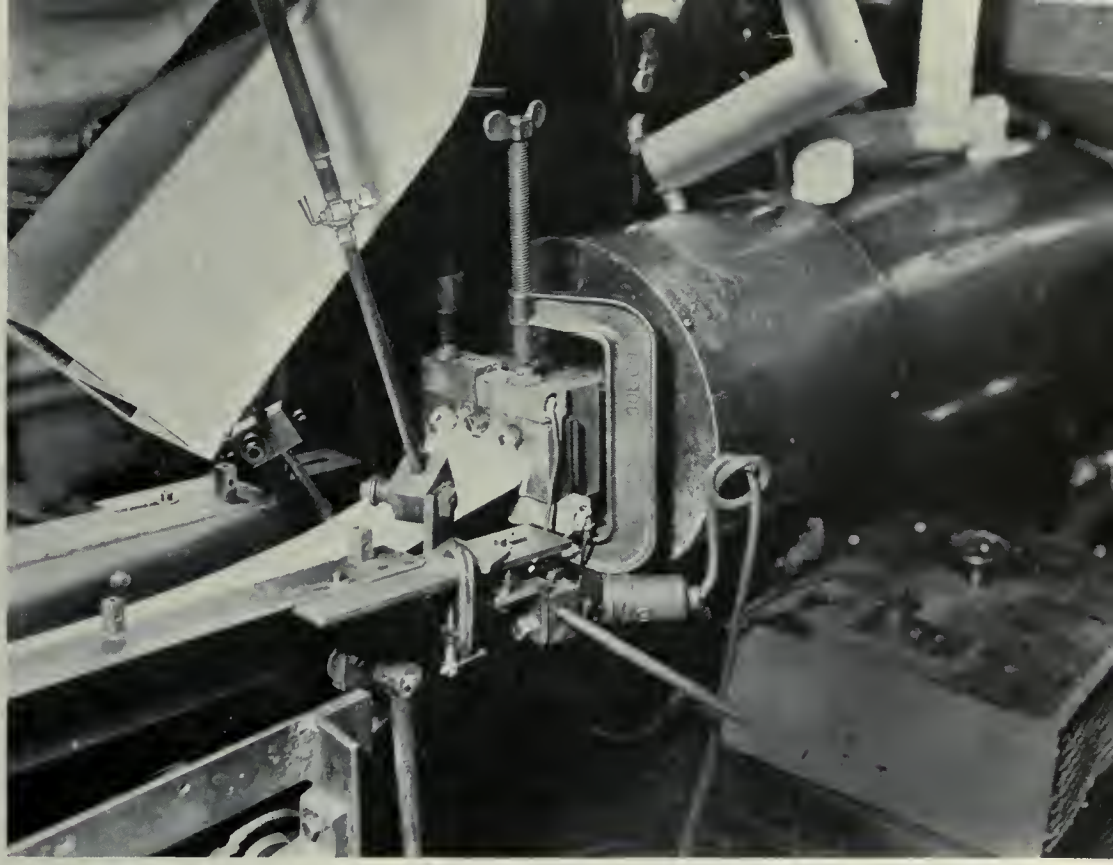
Heart of the portable airport lighting system is the acrylic (Lucite) lenses shown above. Use of an acrylic here makes possible the production of a multi-colored unit which when used in conjunction with an approach light (below left) and markers (below) combines light weight with intense light transmission.



U-channel extrusion end-rail dividers are used with color significance in the Visirecord. Extruded of a cellulose-acetate-butyrate (Tenite II) in .14"-.58" widths



On top of each Visirecord file unit is a transparent facing of Tenite II reinforced with a protecting beaded edge precisely extruded to fit into the end-rails



The transparent butyrate strip is extruded from the nozzle die with a lip on each outside edge to provide a balanced extrusion which does not curl

PRECISION EXTRUSION

Transparent facing strip for card record system is extruded in double width to provide balance and eliminate stress

By Herbert Weston

President, Visible Index Corporation

BEHIND the telegram that so joyously reads, "Your son formerly reported missing has been found . . ." there is a vast record system of vital information. Where the greatest extremes of human emotion respond to the messages sent out by the Casualty Branch of the U. S. Armed Forces, the slightest mistake may mean untold anguish. Therefore, a highly efficient record system had to be employed to reduce the margin of error to the vanishing point. The system, in spite of the vastness of the project, had to be of such scientific simplicity that messages could be speeded to the "next of kin" without a lost moment.

To provide for this accurate transmittal it is essential that each record must be comprehended in one careful glance. Every case history must be in its place with all the vital information clearly visible. Transparent plastic facings make it possible to fulfill these requirements and at the same time satisfy other qualifications. Besides making the records readily readable and instantly accessible,

(*Continued on page 95*)

Extrusion is slit at center to form two top facing strips

Phenolics Facilitate Instrument Production

FABRICATION IS SIMPLIFIED, COST AND ASSEMBLY TIME IS REDUCED

RECENT application of phenolics to two items of U.S. Army Air Forces equipment has indicated the advantages of this plastic not only in saving weight and critical metals, but also in ease and speed of molding, coupled with good dimensional accuracy.

One unit to which this material has been adapted is the "Observoscope," a celestial navigation device produced by John A. Millar Laboratories. The other is an aircraft instrument test set developed by American Aircraft Associates, The McCaskey Register Co., Durez Plastics & Chemicals, Inc., and Plastic Molding Corp.

The Observoscope, which contains a number of adjustable scales, is designed to teach a major part of celestial navigation—obtaining one's location by finding the position of a celestial body—and may soon become an essential part of equipment used in actual navigation.

Shock-resistant phenolic plastic was chosen to replace the seasoned, treated wood formerly used for the upper and lower black parts of the instrument. This change permitted a considerable increase in production speed. Phenolic laminate is replacing brass formerly used in the sighting tube and base. Only adjusting screws will still remain metal.

Used in conjunction with the Observoscope is the list of 55 "navigators' stars." This list and all scales on the Observoscope are made of vinyl in order to insure dimensional stability under all conditions of temperature or atmosphere encountered in use, and to permit cementing or riveting onto the instrument. In the first models the 55 stars were listed on the cylinder of the Observoscope itself, but for greater convenience in use, they are now printed on a separate card. The card contains figures for the sidereal hour angle and declination of each star.

The ease and speed of molding the phenolic laminate used in this instrument has made possible mass production of the unit at a great saving in cost over the earlier models.

Operation of the Observoscope is said to be simple enough to permit anyone to use it with less than an hour of instruction and practice. To locate a star, the upper ball is turned until a pointer indicates the proper sidereal hour angle. Next, the scale in the upper ball is adjusted for declination. Then the two lower central scales are set for local civil time and calendar day. The entire cylinder is tilted for the proper latitude in accordance with a scale on the base mounting. Finally, the arrow on the base is checked so that it points to true North. After these five adjustments, the star is located.

The tester—which is used in the field to determine the accuracy of various instruments used in aircraft operation—was constructed originally almost entirely of metal. The

(*Continued on page 94*)

Observoscope dome, ring and base are of phenolic; scales are vinyl

Redesign of this aircraft instrument test set to use phenolic housing and turntable, improved strength and reduced weight

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From first idea, all the way through design, molds and eomplete finish, the twenty-two years experienced Reynolds organization will expertly engineer your plastic problems . . . today . . . tomorrow.

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ELECTRONIC HEATING

Fig. 1. Electronic heating unit with heating oven specially designed and built by a molder

By Charles S. Dewey and Vernon W. Sherman

Research Engineer
Shaw Insulator Company

Mgr., Industrial Electronics Div.
Federal Telephone & Radio Corporation

THE fundamental value of dielectric heating to the molding industry lies in its ability to heat molding materials uniformly and fast. It is felt that a discussion of representative applications showing the equipment used, the product obtained, and certain practical aspects of the electrical problem will serve to clarify what this new technique means to the molding industry.

This article is presented from two specific viewpoints: (1) The molder who judges the excellence of the job in terms of curing time, pressure requirements, percentage of acetone extraction, etc.; and (2) the equipment manufacturer who judges the job in terms of the workability of this electronic tool on the factory floor. The design viewpoint is also important and by means of photographs, curves, and data, essential design points dealing with the dielectric heating oven will be discussed. This oven can be constructed in the molder's shop or it may be purchased as an accessory from the manufacturer of the electronic heating unit.

There has been much controversial discussion concerning whether the upper electrode need be in contact with the plastic preforms being heated. The answer to this question is a definite—No.

It should be added that it is not only highly desirable to have an air space above the preform being heated, but such an air space is a practical necessity for fast and convenient handling of preforms either individually or on a tray in a molding shop. Some of the early demonstrations of electronic heating were made with the upper electrode pressed into intimate contact with the surface of the preform. This was done to utilize fully the limited power capacity and working voltage of the early laboratory type of high frequency equipment.

During the development of the Megatherm dielectric

OF PREFORMS

A DISCUSSION OF THE PRACTICAL SIDE OF INDUSTRIAL ELECTRONICS AS APPLIED TO THE MOLDING INDUSTRY

heating units it was found that in order to heat the common preform materials at a satisfactory speed, it was desirable to provide about 2500 volts of radio frequency energy per inch of thickness of preform. It was recognized by Federal engineers that considerably more than this voltage would have to be available from the dielectric heating unit in order to accommodate preforms within the thickness range which molders had stated they would like to be able to handle. A basic performance was set as the heating of 2 lb. of preform to a temperature of 300°F in 60 sec. It was further decided that an output working voltage adjustable from a lower value of 5000 volts to an upper value of 10,000 volts should be provided. This meant, in terms of practical preform thicknesses, that the unit would be able to heat preforms up to 3" in thickness in 60 sec., and thicker preforms in correspondingly longer periods.

Fig. 1 shows one of the electronic heating units together with the heating cage which was designed and constructed in a molding company's shop. Note that the preforms are setting on a tray formed from an ordinary piece of sheet metal. The function of the enclosing oven is two-fold:—(1) protection for the operator; (2) prevention of radio interference.

It should be emphasized that the heating plates work with a radio frequency voltage and not a power voltage. The operator can receive a burn much like that due to touching a hot soldering iron, but he does not feel a "shock," and the voltage is not lethal since the circuit from which it is derived is completely isolated from the d-c power pack which supplies the power tube. Actually, the two heating plates are connected directly to the opposite ends of a heavy copper tubing coil whose center point is permanently attached directly to ground. In the circuit used by this unit, all possibility of a power voltage occurring on the plates is eliminated, regardless

Fig. 2. Preforms in press transfer chamber after they were preheated in the dielectric oven. Handling several preforms slows the loading and molding time

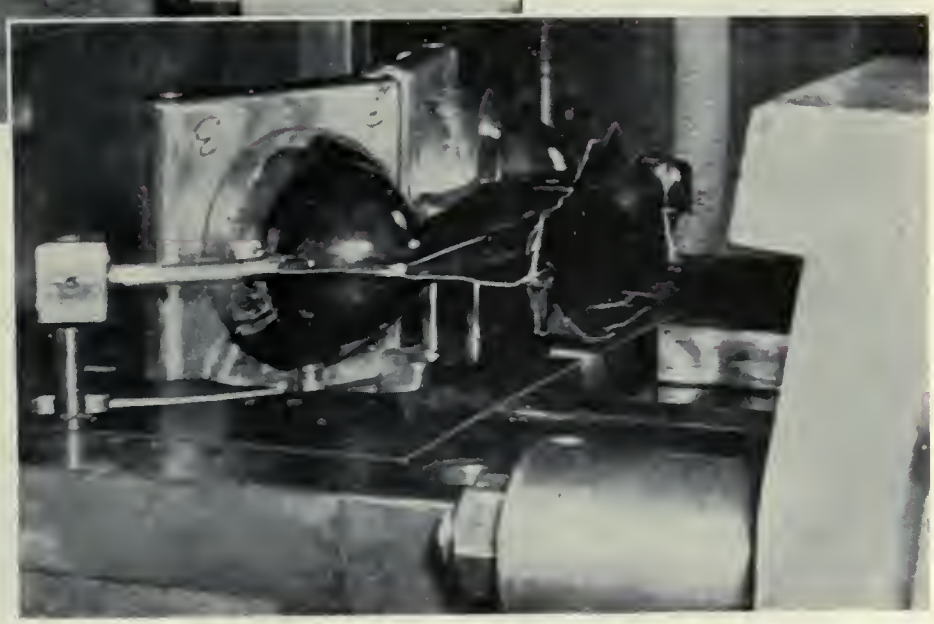

Fig. 3. The molded part, the flash and the cull, as they are being ejected from the mold after a molding period of 30 seconds

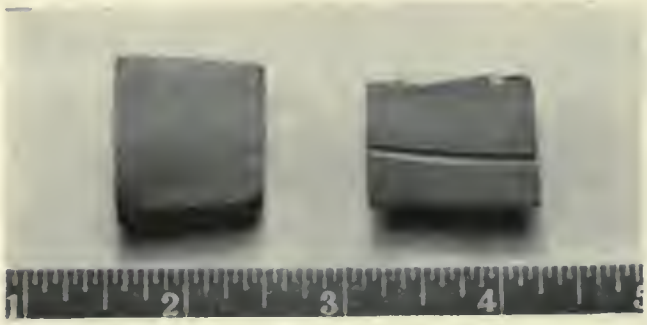

Fig. 4. Two pieces of molded material, the part at the left having had no electronic preheat

of the nature of possible failure or trouble anywhere in the unit.

It will be noted from Fig. 1 that an interlock contact is mounted on the oven door so that when the door is open it is not possible to apply radio frequency energy to the heating plates. The oven shown is fabricated from an angle iron and galvanized sheet metal, and uses a pair of steel plates ¼" by 12" by 12" insulated with 6" porcelain stand off insulators. The upper electrode plate can be raised or lowered so as to adapt the spacing between the heating plates to a proper value for the preforms being run. The door is mounted so as to be closed by circular motion with very little effort.

On the shows a commercial form of this oven, the door drops when the mushroom shaped button is pushed by the operator. It has a circuit interlock and has a luminescent indicator built inside near the top of the unit. Here again the upper plate is adjustable (to accommodate preforms up to 6" in height). The plates used are 10" by 14" and are spaced far enough away from the walls of the enclosure to permit the use of a molding tray if desired.

Molding of Preheated Materials

Fig. 2 shows the preforms in the transfer chamber of the press immediately after being taken from the 30-sec. heat treat in the dielectric oven. The preforms are shown in a standard angle press with the transfer chamber divided in the middle and the gate readily discernible. The chamber closing time is approximately 5 sec. This could be speeded up by enlarging the gate or by increasing the preheat of the preforms. It should be cautioned, however, that when too much preheat is used, the preforms have to be handled more rapidly since they have been brought closer to the point where they are about to "set up". Just how much preheat can be tolerated is a matter each molder has to decide experimentally since different molding materials react in their own characteristic way.

Fig. 5. Extreme plasticity of this dielectrically-heated preform was shown by easily pushing a pencil through it

It is also necessary to recognize that the handling facilities between the dielectric oven and the mold may be a factor determining how close to the maximum preheat the molder will choose to work. Expressions of opinion from the molding field indicate that practical preheats range from as low as 200°F to as high as 320°F, depending upon the material and the individual molder's technique.

The preforms shown in the press in Fig. 2 were heated 30 sec., but this heating time could have been substantially reduced by the use of one large preform instead of the several small ones. It is also well recognized that in Fig. 2, loading would have been facilitated if the operator had to handle only one preform instead of the several shown.

Fig. 3 shows the molded part, a telephone handset, with the flash and the cull, being ejected from the mold.

The molding time has been reduced from the usual 5 min. down to 30 sec. by means of electronic preheating. Microscopic inspection of the molded material showed that the use of the high frequency preheat was distinctly beneficial, securing a complete and uniform cure, free of all internal stress.

Fig. 4 shows two sectional views. The piece on the left was given what was thought to be a full cure, but without the benefit of electronic preheat. In spite of its good external appearance, it was found upon sectioning that small internal cracks, discernible to the eye, were present. It is possible that additional experimentation as to curing time, etc., might have given better results. However, the use of electronic preheat was tried next and the results appear in the right sectional view, which upon closest inspection shows a completely uniform cure in spite of the fact that a 30-sec. cure rather than a 5-min. cure had been used.

Acetone extraction tests performed on sample gave the following results, as a function of the amount of electronic preheat and the duration of cure:

Shot #	H.F.Heat (sec.)	Cure (sec.)	Acetone Extractives (Total %)
Standard	none	300-420	2.1
1	40	120	2.4
6	40	42	2.6
9	41	20	2.0
13	40	23	2.0

It is possible that the 5-min. cure found to be necessary without electronic preheating could have been reduced somewhat by the use of infra-red lamps of some other preheat method. Even with these aids, however the cure time for this particular piece would hardly be reduced to anything near the seconds possible with the uniform deep electronic heat.

As a general rule, it has been found that the use of dielectric heating may be expected to reduce the cure time to about 25% of that formerly required with conventional molding technique.

It is desirable to locate the electronic preheating unit close to the press in order to use it to the utmost advantage. When the preform has to be carried several feet to the molding machine, the inefficiency of this material handling imposes a real penalty on the normal advantages of the dielectric heating technique. Obviously, when the unit is coupled with the molding cycle so closely that no appre-

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NO ONE WOULD USE BRASS FOR A TOOTH PASTE TUBE...

It ruffles our calm to hear a voice raised in unjust protest against plastics. The man who wouldn't use brass for a tooth paste tube would, more likely than not, use a cellulose acetate plastic instead of a cast phenolic.

In the plastics family there are as many types and kinds as in the family of metals. There are plastics for eye appeal; others for strength; some that don't mind heat, but can't stand the gaff of wear and tear; plastics that take to water, and some that don't.

Knowing the limitations of these plastics, and how to mold them economically into products, is our service to industry. We've been doing it for twenty-six years. And our list of customers tells us we've done a pretty good job.

At the moment, our principal customer, Uncle Sam, is keeping us working around the clock. But, with an eye to the future, we'd like you to read our concise digest of the industry, "A Ready Reference for Plastics." It contains all you'll ever want to know about plastics. Easy to read and fascinating. Write for a copy on your business letterhead.

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Fig. 6. High frequency preheating was used in molding this group of parts and their complex inserts

ciable delay occurs between the preheat cycle and the compression of the preform in the mold or in the transfer chamber, a substantially higher heat may be successfully utilized in the preheating stage. It is further recognized that to take full advantage of this additional preheat, it may even be necessary to modify the mold temperature which will in turn effect a further reduction of required curing time.

Plasticity Advantages

The extreme plasticity which is reached by the preform in consequence of dielectric heating is demonstrated graphically by Fig. 5. An ordinary lead pencil was pushed through a 4" diameter preform with great ease. The fact that this preform was made in a 75-ton press, will convey some idea as to its density and hardness prior to softening it with dielectric heat. To visualize a further demonstration—squeezing between the hands would break a preform in much the some manner as a housewife would open a hot biscuit.

The molding of large parts can be readily handled when the preform is heated with high frequency energy. In Fig. 6 is a lamp handle (second from left) currently being produced from BM-3510 (Bakelite high impact phenolic), the weight 510.5 grams, the total charge being approximately 550 grams. Two gates were used in the transfer process, one coming in from either side of the mold, the diameter of these gates being approximately ⅛". It was observed during the initial use of preheating, that the mold filled immediately and with little effort. It was actually found possible to stop one gate and thus force the entire preform into the mold through a single ⅛" i.d. gate. This was felt to constitute a new high in the matter of evaluating the plasticity of preforms, since it would certainly be inconceivable to ever have filled such a mold through a single ⅛" gate using a conventional press without the benefit of high frequency preheating.

Groups of parts with complex inserts which have been satisfactorily molded utilizing high frequency preheating are shown in Fig. 6. It will be noted that there are two types of distributor heads. These were produced from melamine-formaldehyde (Melmac 592). The large distributor head on the left side weighs approximately 3 lb. Closing of the transfer chamber in as low as 6 to 8 sec has been achieved and again a very worthwhile reduction of the curing time.

Cost of Dielectric Heat

The cost of operation of the 3 kw output electronic preheating unit used in the course of the work described by this article, total 16.7 c per hour, broken down as follows: 4.2c for power, 7c for industrial power tubes, and 5.5c per hour for amortization of Megatherm unit.

These costs are based on an anticipated average life of 5000 hours for the industrial power tubes and for the industrial rectifier tubes. (In the case of the latter, a figure of 10 000 will probably be much closer to the actual.) The cost of industrial power was assumed to be 1.5c-kw hr, and the duty cycle of the unit 50%. In other words, the "power off" period. With a 3 kw output from the unit the power input is 5 kva (4.75 kw), power factor 95%. At no load power, input is 600 watts and is accounted for by the filament load of the tubes and the cooling air blower.

Amortization was calculated on the assumption that the original investment of $2618 (unit less tubes) would be amortized over a 10-year period and that the unit would be used 4800 hours a year.

Dielectric of Plate Spacing

It was pointed out that it was highly desirable from a practical standpoint to have an air space above the preform and that in order to do so, the dielectric heating unit would have to be able to produce a certain extra amount of voltage. If the total space between the two heating plates is occupied half by the preform material and half by air, then the total available working voltage will divide between the air and the preform inversely as their dielectric constants. For example, if the dielectric constant of the preform were 3 as compared to a dielectric constant for air of 1, then ¼ of the total working voltage would appear across the preform material, whereas ¾ of it would appear across the air. It should be stated, however, that when 75% of the voltage is across the air space it does not mean that 75% of the power output of the unit is being

(*Continued on page 89*)

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Too big for single dipping, this shaft is dipped twice, one end each time

This part will remain suspended in the dipping pot for about two seconds

PROTECTING

Quickly-applied transparent dip assures corrosion-free parts as needed at war fronts

A LABOR-SAVING dip wrap of an ethyl cellulose base has been put to use by the General Motors Corporation, GMC, Truck and Coach Division at Pontiac, Mich., to solve its wartime packaging problems. Along with the advantage of being transparent, this wrapping is expected to have many important post-war applications in various fields, since it not only gives superior protection of the wrapped metal products at greatly reduced costs, but also provides new sales appeal and convenience in handling, stocking, and display.

The need for such a wrapping was created when the company was required to ship 325,000 individual parts a day—practically all of it to the armed forces, including a considerable portion to overseas storehouses. Exposed to the deleterious effects of a transoceanic journey and, in many instances to the moisture of subtropical lands, it became necessary to pack these parts in a wrapping which would not only eliminate the danger of rust and corrosion by keeping moisture out, but which would also facilitate and speed packaging and handling.

Previous packaging methods and materials fell far short of meeting this new combination of needs and so General Motors began experimenting. Past experience was concentrated principally on first hand wrapping the part in unwaxed paper, then in a self-sealing wax impregnated cloth laminated with a sheet of cellulose and then double-dipping in wax for final sealing. In most instances this gave satisfactory protection, but it was a costly and laborious process, particularly when small parts were being handled.

Air shut in the empty spaces of the wrapped parts necessitated further protection against rust, and gears, for instance, were first dipped in a corrosion-preventive oil.

In first experiments, bearing shells were protected with a "stop-off" lacquer, but this was unsatisfactory because of brittleness. Then chemical companies working with GMC turned to ethyl cellulose. The original plastics mix was too tacky, and dripped for two minutes after dipping. Ultimately, when the portion of ethyl cellulose in the mix was dropped from 35% to 25% dripping time was reduced to 10 seconds. The result was the formula now being used to obtain the finished dip compound.

Hercules Powder Company, Wilmington, Del., is the basic supplier, Seibert Varnish Company, Detroit, is the converter, and Dow Chemical Company, Midland, Mich., is the fabricator of the finished plastic dip. The basic composition is approximately 25% ethyl cellulose, 25% resin and plasticizer, and 50% mineral oil and wax. The principle purpose of the resin and plasticizer is to hold the high percentage of oil as a gel. About 1% of stabilizer (rubber inhibitor) is sometimes used to prevent the ethyl cellulose from breaking down under the heat to which it is subjected.

Exudation of oil must be 10% by specification but experience and test of the material shows that it is now running under 3%. A small amount of internal exudation, upon the surface of wrapped metal, is considered desir-

METAL PARTS BY ONE-COAT DIPPING

By H. F. Reves, Special Correspondent

able, as this gives an added safety factor as a corrosion preventive.

Evaporation is practically zero, inasmuch as there are almost no volatile constituents. There is a slight loss of plasticizer, by weight, but this is insignificant inasmuch as the stability of ethyl cellulose and other ingredients is far more important.

Adequacy of the protection afforded the metal part is determined by detailed tests, including a humidity test at 100°F in 100% relative humidity for 720 hours, after which the test panel must show no signs of oxidation when stripped.

There also is rigid cycle test in which the equivalent of about 25 years' normal use is simulated in ten days. The daily subjection is to 16 hours at 100° in 100% relative humidity, then 3 hours at –40°, then 2 hours at 160° followed by 3 hours immersion in 5% sodium chloride solution at room temperature. This gives daily alternate experience of humidity, extreme cold and heat, and saline immersion.

Other essential properties of the compound are indicated by the Ordnance specifications in the accompanying table:

ETHYL CELLULOSE PROTECTIVE STRIPPING COMPOUND (Hot Dipping)
(U.S. Army Specification AXS-1167)

Fire Point: (min.)	410°F
Film Thickness: (at 372°-378°)	0.099"—0.101"
Tensile Strength: (min.)	450 psi
Elongation: Average in 2" section (min.)	50%
Stability: (After aging at 370°-380° for 48 hrs. without gelling or seperation) Viscosity:	within 20% of coating value
Min Ten. strength:	350 psi
Min. elongation:	40%
Exudation: by wt. at 160° F for 24 hrs. (max.) (Test Film—2" x 3" x 0.050")	10% loss
Plasticity: 0.500" film compresses to (min.)	0.150"
Brittleness: (No cracking, flaking or seperating)	Alternate exposures* 157° to —43°
Corrosion: Immersed* not to exceed corrosion in air* at	370°-380°

*24 hour periods

Dipping Procedure

The compound is received from the supplier in blocks, and machine-sawed into 9″ by 3″ by 2″ portions to facilitate melting. It is placed in the "mother" pot, in which it is heated to between 350° and 375°F. About 90 minutes are required to bring it up to this temperature.

The mother pot is so placed that it discharges through a heated spout by gravity into the dipping pot, when the outlet valve is opened. Both pots, which are separately heated, have a total capacity of about 15 gallons. Working temperature is the same in both pots.

In operation, fresh compound is added at regular intervals, rather than all at once, so that the entire dip is normally replenished every three to four hours.

The part to be dipped is suspended by a waxed string, into which a knot is first tied by machine; this is then

Typical scene at a dipping pot, with the inspector examining a dipped part which has been water-cooled

Dip-wrap is easily stripped from a bearing assembly. It comes off in one piece, leaves no residue on part

Under old method of wrapping, four steps were required: cleaning, corrosion preventing, wrapping in Grade C and double dipping in wax

Now, only two steps are needed: cleaning and plastic dipping

looped or tied around the part. It is then dipped into a cleaning solution of di- or tri-ethylene chloride; no oil dip is required. Next, the part is lowered into the dipping pot by hand, held there for about two seconds, pulled out and the immediate runoff of solution allowed to drop back into the pot. Compound which drips onto the table or floor may be easily salvaged for reuse, minimizing waste. The part is then dipped into cold water, which cools and hardens the wrap within about five seconds, and which removes any fine "hairs" which may remain after the dip. It is then ready for passing on to a conveyor or other means of removal.

Longer parts which cannot be completely submerged in the dipping pot are double dipped, one end at a time.

Operators have tried wearing gloves for protection, but their use has been found awkward; and, since there is little splash, it is unnecessary to insist upon them.

It has been found that the occasional formation of a bubble in the coating, as over an open space, can be smoothed out through heat applied with a soldering iron.

The system is still in its early stages, but a development of a conveyor type of dip that will speed the process and eliminate the labor of hand-dipping is already under way. The conveyor, with the parts suspended on it, will drop each piece into the dipping pot for the required time, and then carry it on, cooling the coating by air as it travels along, thereby eliminating the water dip.

Experience indicates that the ideal heating unit would be a single mother pot connected by a piping system to a battery of dipping pots, or a mobile mother pot which would travel up to each dipping pot as needed.

Further suggestions for the permanent installation include an oil jacket for heating the pots, to allow uniform heating and agitation of the pot, thus preventing the plastic from settling around the outside because of its low conductivity of heat. Electric strip heaters are now being used.

At the completion of the dipping procedure, parts are normally packaged in cartons, except for long parts. The use of cartons can eventually be eliminated since the coating has repeatedly stood up under severe test, without further covering. One box of parts was carried for days in a truck over rough roads, and then subjected to a vibrating machine ten times more severe than the parts would ever be subjected to in actual shipping practice with a damage of less than 2%.

Lettering, after the part is coated, is still visible as on the uncoated part

Stripping

The waxed string (or occasionally a wire) used to suspend the part in the dip is left on the coated part, and it may be used as a cutting medium to strip off the coat.

On parts with no string, the coating may be stripped away with a sharp instrument. For field use, a sharp whittled stick is recommended, rather than a knife, to prevent damage to the protected surface beneath. However, where speed is important, or where sufficient care can be exercised, use of a knife is practical. By warming the coated part with water at 200° for about a minute, or by any other means of artificial heat, the coating will become pliable and can be stripped by hand.

Dips to Suit the Parts

Any type of part suitable for plastic which is small enough to be immersed in the available pots—15 gallons in GMC present practice—can be coated in this manner. At present, nothing larger than an automotive crankshaft has been so dipped. The possibility of conveyor dipping of much larger pieces in pots of sufficient size is obvious.

On a part such as a drive shaft, older methods did not give a tight over-all seal. Now, each end is dipped separately and fully protected over the machined ends. The central portion of the shaft, which is rough-finished rather than machined, is not coated and is adequately protected by some other type of corrosion preventive. Only the precision machined surfaces require the extra protection.

Surfaces other than metal can also be coated. Typically,

(*Continued on page 98*)

For War Production and Post-War Competition

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WAR-PROVED through the production of thousands of different plastics parts to the most exacting government specifications — the Stokes Completely Automatic Molding Machine offers post-war economies no executive can afford to overlook.

For it permits him to make the plastics parts he needs, as he needs them, right in his own plant by a completely automatic method requiring only a minimum of skilled labor, and at savings which many times have paid for the entire investment in a matter of months.

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Automatic Molding saves labor . . . machines are completely automatic.

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It is none too soon to investigate Automatic Molding for many parts that will go into your post-war products. Stokes engineers who pioneered Automatic Molding have helped many manufacturers apply it to the solution of their individual problems.

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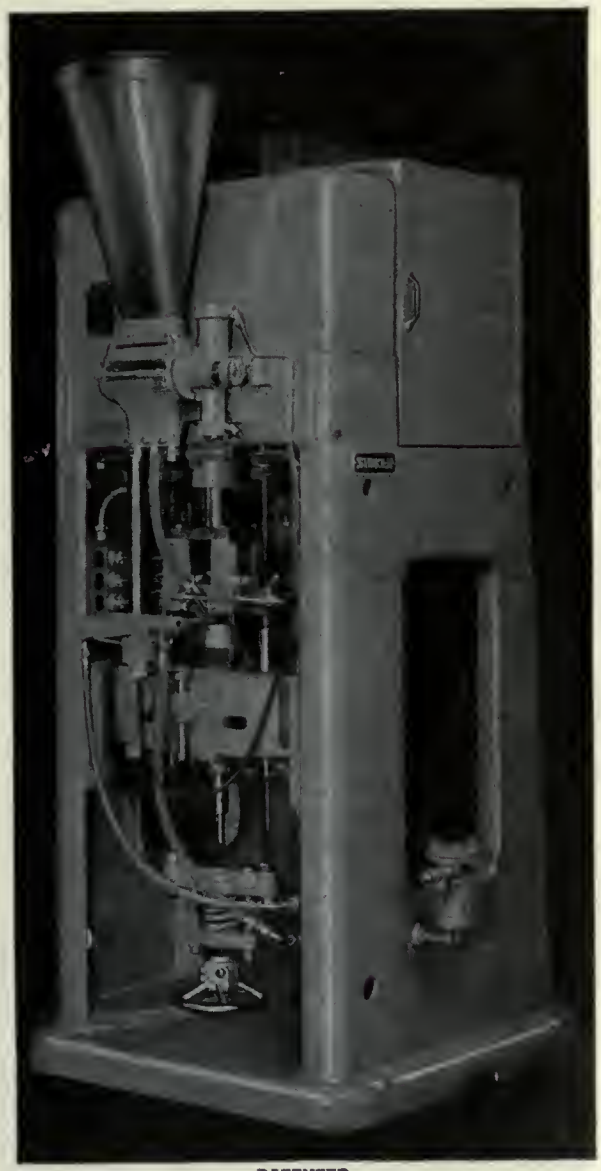

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Metal Plating of PLASTICS

By Joseph Rauch

Chief Research Engineer, Metaplast Co.

ELECTRODEPOSITION OF METALS ON VARIOUS PLASTICS MATERIALS IMPROVES THEIR PROPERTIES

Strength and shielding properties acquired by copper and cadmium platings on this swivel joint housing made it possible to mold it of weight-saving plastic

IN the past five years great strides have been made in the process of metal plating on plastics. Back in 1938 when the process was first patented it was difficult to imagine that five years hence plating on plastics would play an important role in our war production. By 1941, large scale civilian applications of metal plated plastics were routine and it is interesting to note that the progress made in this field has measured up in every way against the ultimate in precision specifications and standards required by Army-Navy aeronautical engineers.

The Metaplast process is one which makes possible the electrodeposition of a smooth, non-porous, adhesive metal coating, in certain specified thicknesses, on almost any shape of non-conductive material and at the same time maintains the detail of the underlying surface.

Many combinations of metals and methods of internal and external plating are possible, depending on the desired properties such as high electrical conductivity, resistance to vibrational-stress, dimensional stability, decorative effect, abrasive resistance, heat resistance, moisture resistance or reflective qualities. The physical properties of the plated part depend upon the base material, type of metal deposited, thickness of deposit and design of plastics part to be plated.

The plating can be adapted to give a soft or a hard deposit and in surface finishes ranging from a dull matte to a high polish. Naturally, the thickness of the plated metal will alter the physical appearance of the piece. The coating can be controlled to produce thicknesses from .0001" to .250" depending upon the desired use.

Properties Imparted

In general, the thermal resistance of a plastic is raised by coating with a metal. In certain cases, the distortion temperature of a thermoplastic is raised as much as 50°F. For example, the distortion temperature of some plated cellulose acetate becomes 150°-200°F instead of 140°-160°F. Phenolics which may only take 300°F can be made to resist 500°F. With metal coated plastics the possibility of localized overheating is considerably reduced since the plated surface distributes excessive heat over a wide area through dissipation and conduction. Furthermore, the plated surface with greater heat conduction assures a more rapid return to normal temperature.

By completely enveloping the plastic in a metal coating, the water absorption of the unplated plastic is greatly reduced. Cellulose acetate having a water absorption of 2.5% in twenty-four hours in unplated form absorbs only 0.1% when plated with approximately 0.002" of metal.

(*Continued on page* 106).

Weight is saved and shielding is accomplished by metal plating plastic panels, retaining their printing qualities

Compreg wood antenna mast, copper plated

Cut-away view of loop antenna with coil loop housing of polystyrene metal plated

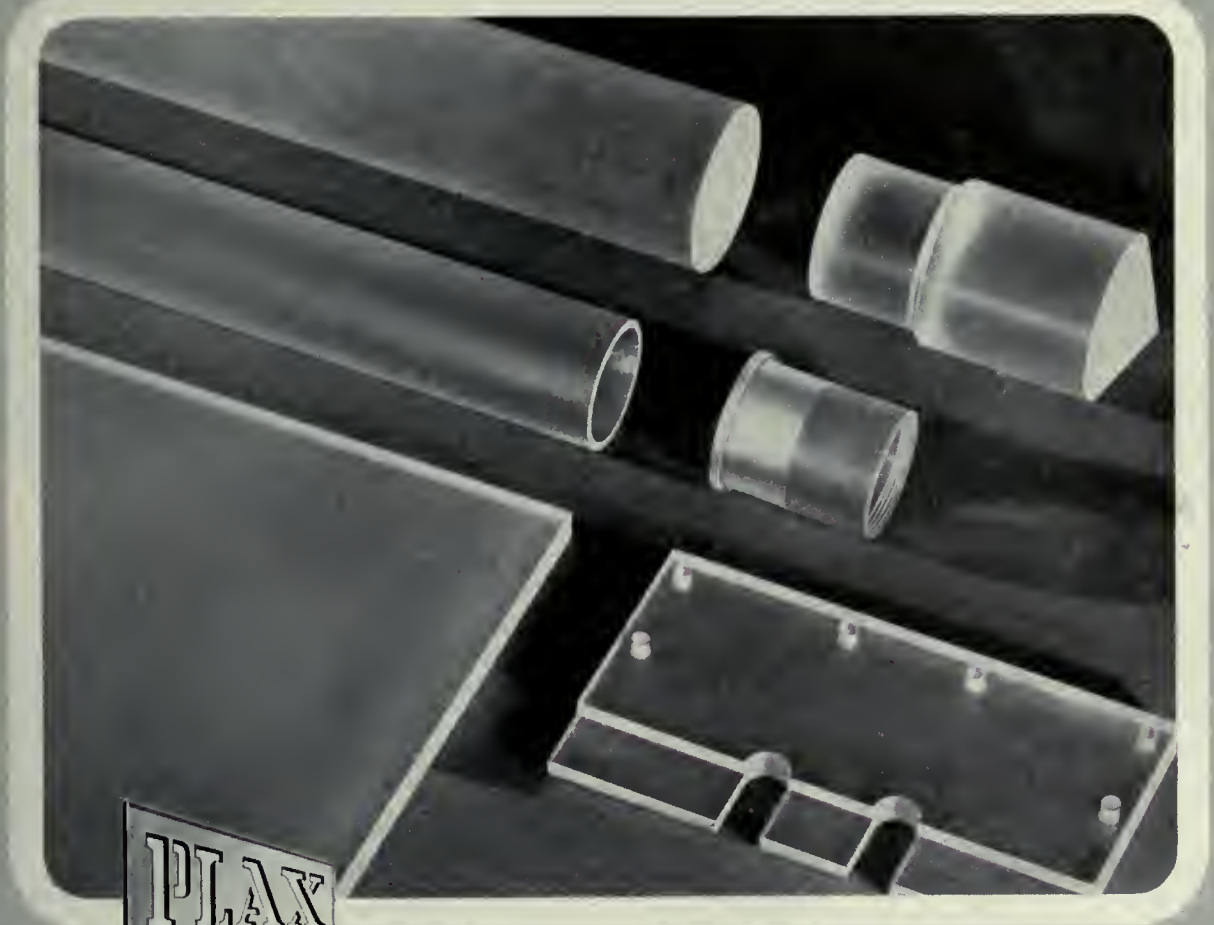
PLAX POLYSTYRENE *Sheet, Rod, and Tube Application Hints*

"Polystyrene has been found to be best suited to the process due to its chemical inactivity, dimensional stability, and moldability. The low water absorption . . .

—Electronic Industries, Oct. 1943, p. 75

"Polystyrene was selected for this application because it has good acid resistance and can be machined readily to close tolerances . . ."

—Product Engineering, Oct. 1943, p. 623



PLAX FOR PLASTICS

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Plax's bulletin on machining polystyrene (available to you on request) is helping many manufacturers use available production facilities to turn electronics' most versatile insulating material into a wide variety of high-frequency components.

Write the Plax Corporation, 133 Walnut St., Hartford 5, Conn., for sheets giving complete data on polystyrene's unique physical, chemical, electrical, and thermal characteristics . . . and for data on other interesting plastics now fabricated by Plax.

PLASTICS AT WORK

in Home and Office

Typical of how laminates can brighten an office. Desk and table, as well as walls and window sills, are of Formica sheets and panels veneered to wood cores, laminated and finished with Bakelite phenolic resins

A popular use of plastics that will return in post-war is for home portable radios such as for this attractive model which was designed by Barnes & Reinecke for Majestic

Decorative display table of opaque black methacrylate top with contrasting transparent ornamentation and legs of the same plastic. Designed and fabricated by the House of Plastics, Cleveland

PLASTICS AT WORK

in Utility Service

Plastics construction has enhanced the new Zenith hearing aid and reduced its price. The earphone is of melamine; the amplifier unit (close up) is polystyrene

Shatter-resistant tableware for U. S. Naval vessels and patrol bombers. Lighter and less bulky than crockery and resistant to food acids and stains. Molded of Plaskon melamine-formaldehyde

This Vinylite coated fabric, on the seat of a cab which had gone over 100,000 miles, looks none the worse for wear. This material is used on jeep seats

Train seats upholstered in Firestone Velon (vinylidene chloride). Various car stylings are possible in Velon's colors and patterns. It is easily cleaned, long wearing, and non-inflammable

PLASTICS AT WORK

in Aircraft

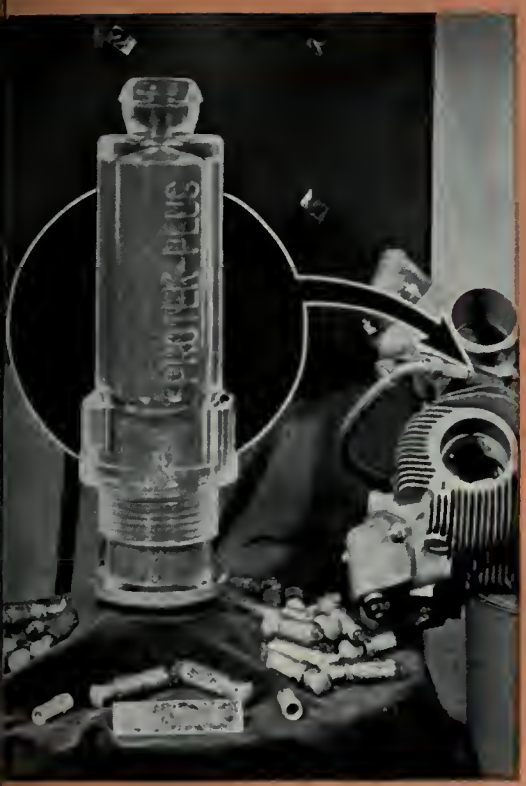
Transparent butyrate vacuum block for aircraft oil lines. It demonstrates the adaptability of transparent plastics to industrial plumbing inspection points

Compartment door on Martin B-26 Marauder embodying pressed phenolic laminate for considerable weight-saving and high strength. This construction is applicable to many transportation structural units

Panelyte phenolic laminate flooring in Martin Mars flying boat. Its light weight and high strength qualifies it for use as flooring in buses, boats and other transportation

High-impact Bakelite phenolic parts, for gun turret trigger assembly, passes tests at —70° to +180°F., suggesting this use for farm and construction machinery controls

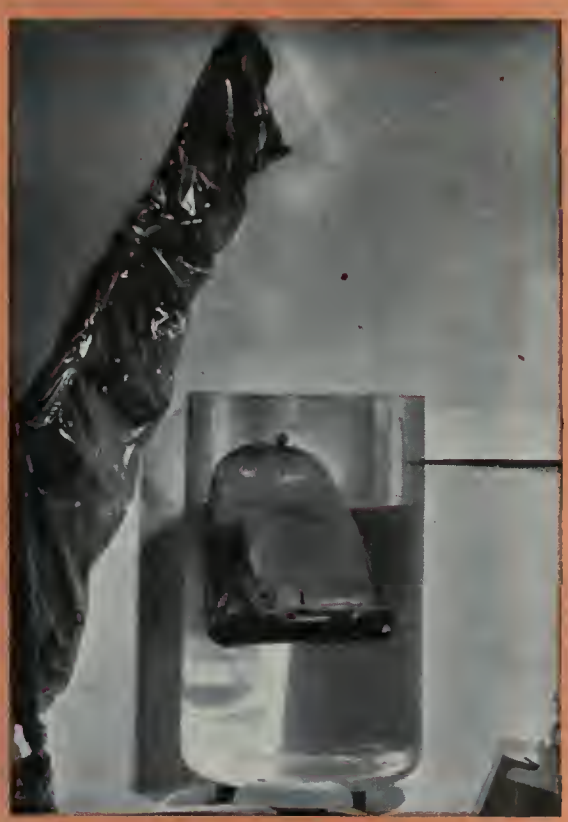
PLASTICS AT WORK
at the Packaging Show



"Protek-Plug" of transparent butyrate protects motors in shipment and provides visual color-checking of silica gel condition. Shown by Chandler-Evans Corp.

Shown along with new container designs of Tenite, are items of the same cellulose acetate plastic in war-essential use—transparent tape (background) wire wrapping and wire-reinforced tubular container (foreground)

Packaging-to-come is exemplified in the Central States Paper & Bag Co. exhibit of attractive display packages in contrasting shapes, sizes and colors. They are formed from transparent and colored acetate sheetings



A demonstration of protective wrapping of side arms in Lumarith film. Guns, thus wrapped, will float (as shown), remain dry, and may be operated without first unwrapping

All cowl skins on this Curtiss Commando are formed on plastic dies

PLASTIC DIES SPEED AIRCRAFT PRODUCTION

By H. W. Tompkins

Airplane Division, Curtiss-Wright Corp.

TOOLING COST AND PRODUCTION TIME CUT THROUGH USE OF PLASTIC DIES

Small punched piece and its draw-die cast of thermosetting resin

THE liquid thermosetting resin was slowly poured into the mold—just six hours later it was installed on a punch press blanking .064" SO Alclad sheet Aluminum! Fantastic as this may sound, it actually took place in the Buffalo Plants of the Curtiss-Wright Corporation in the spring of 1943 under the direction of the Plastic Tooling Division as an experimental project!

Extensive use has been made of thermoplastics in the production of aircraft parts in the west coast aircraft companies where the plastics tooling development had its inception. As these companies branched out toward the south and east, the process progressed so that the use of thermoplastics as a practical production process is an accepted standard, particularly in the drop hammer departments of many companies. The outstanding advantage of this material is that it may be fully reclaimed and repoured after completing its production run.

While used in a wide variety of checking fixtures and drill jigs, maximum labor savings are made in the drop hammer application since the plastic is poured into the

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When it comes to finish, accuracy and speed of production, the advantages are all with the hobbed cavity.

When it comes to experience, "know-how" and facilities for producing hobbed cavities, the experience of leading molders in all parts of the country points to Midland Die & Engraving Company as a preferred source.

The new brochure, "Shaping Tomorrow Today" explains the vital part in plastics played by the hobbed cavity. Every designer, molder and manufacturer should have a copy—

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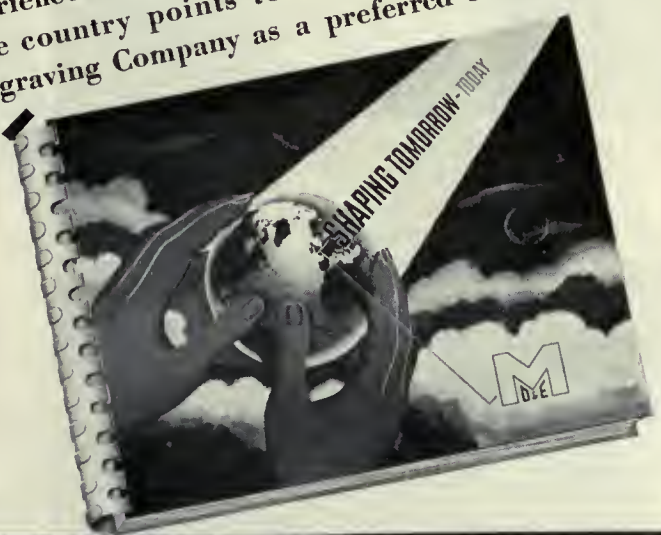

Hobbed Cavities *by* Midland...

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A plaster mold for a draw-die punch is touched up after removal from its pattern. It is then coated with acid-resistant paint and hard wax

Stretch press form cast of liquid thermosetting resin which was poured and cured in mold shown at left. Mold is reused many times

This draw die punch is being carefully sanded by hand to give it a final surface finish before the pressure pads are fitted around it

metal die and consequently, it produces an exact matching punch which requires no expensive grinding to produce a proper fit. Reworking costs are also reduced since the punch may be "dressed" by heating the metal die and pressing the plastic punch into it.

Vast and diverse as is the scope of thermoplastics, the field which now appears to hold great promise is the thermosetting liquid casting resins. This material was extensively used in the pre-war period for buttons, juke box decorations and panels, objects of art, ash trays and countless small novelties involving small mass. Many times it was mixed with some type of "loading" material when structural value was not expected or required. Most of these liquid casting resins were processed right in the resin manufacturer's plant since the process had to be carried through from beginning to end without interruption.

War found these manufacturers with volume production facilities for resins which could no longer be used in the domestic field and hence would be idle unless suitable wartime application could be found.

At that same time, Harold Clark, a man with many years of plastic experience who was also feeling the curtailment of the domestic plastic field, joined the Buffalo plants of the Curtiss-Wright Corporation. His hope was to develop the industrial application of plastics, particularly the liquid casting resins.

Under his guidance, eleven phenol-formaldehyde resins were investigated and classified. It became apparent that in the industrial applications to which the various resins were subjected, the results obtained were vastly different from the published data covering the physical properties of these resins. Further investigations proved that this discrepancy came from the difference in the mass of the resin used in each application. For example, the physical properties of two 1" cubes of resin were different if one cube was obtained by casting and curing 1 cu. in. of the material and the other one obtained by taking a cube from the center of a 10" cube of the resin.

Without benefit of special equipment, both accelerated and non-accelerated thermosetting resins were successfully applied to sufficiently diversified fields to substantiate Clark's belief that the materials had many industrial possibilities.

One outstanding result is the application of these resins to the large draw dies used in the 750-ton hydro presses where currently a wide variety of sizes and shapes of aluminum alloy skins and ducts are being formed over plastic. From a minor beginning, the use of these plastic draw-die punches has progressed to a point where all of the metal skins for the engine cowls of the Curtiss C-46 *Commando* are now formed over plastics. These cowls measure 66" in diameter at the firewall and house the 18-cylinder Pratt & Whitney engines which power this transport. Four skins are required for each cowl—right and left sides, top and bottom. While the contours of the side cowl skins are gentle, the bottom cowl skin is larger and deeper and the top cowl skin is long and narrow and the forming is quite severe.

When used in the draw-dies, the force on the plastic is entirely compressive and the material now in use will form thousands of parts with no visible sign of wear.

Since the proper ovens were not available for curing the non-accelerated resins, much of the early work at Curtiss-Wright was accomplished with the accelerated types. It was determined at an early date that the accelerator percentages had to be sharply reduced as the bulk or mass of the pour increased. Vicious reactions sometimes occurred and the excessive heat resulted in decreased compressive strength. As these early large castings aged,

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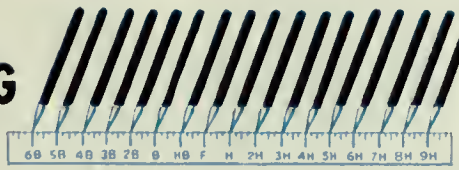

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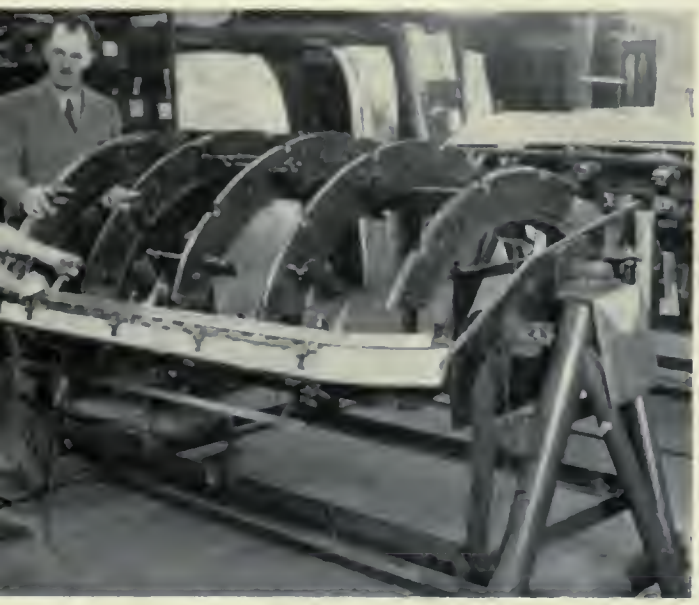
lose-up of cast plastic die, mounted in stretch press, showing aluminum sheet in press jaws being stretched into the shape of the die



his plastics beam, mounted foremost in this assembly and drilling xture, has not varied over 0.002" after 11 months of continuous use

Plastic form on which router frame (bolted to cast-in inserts) secures belly fairing for contour trimming by air-driven router

surface checks appeared. Some of the punches still in use are the early castings and, although badly checked, they are still performing perfectly in the draw-dies.

Resin suppliers have cooperated with Curtiss-Wright and one supplier has apparently been successful in eliminating this checking from his product. However, when time is a factor, the more rapid curing of the casting dictates that the accelerated resin be used and it is hoped that still more progress will be made in this particular branch.

A problem which is peculiar to the aircraft industry is the necessity of maintaining flexibility in production to enable important changes. These changes requested by the Army and Navy, are based on combat experience or changes in requirements. Thus it is impossible to know how many planes will be produced before changes are made.

Also, the aluminum used in aircraft construction is easily formed and it is, therefore, possible to use either lighter tooling or other materials which would not be applicable to forming steel. For example, steel draw-dies, synonymous with mass production, each day turn out countless sheet steel parts. But because of the soft and ductile nature of aluminum it is, in many cases, possible to substitute a punch made of wood or iron which will turn out excellent and accurate parts and cost substantially less than steel draw-dies. However, when stored between production runs, the wooden punches absorb moisture, causing them to expand so that when again installed on the hydro press it may not produce an accurate part.

This is the job which is being rapidly taken over by plastics. The stable nature of the material, its resistance to moisture and the smooth and slippery nature of the working surface plus the ease of producing the punch are factors which are accounting for both increased production and decreased first cost.

Another aircraft production use of plastic forms is in the stretch press, a machine which grasps a sheet of metal between massive jaws and stretches it over a form having the desired contour. New applications are being steadily assigned to this machine and it is currently forming over plastics, a large number of different parts, among them a "transition skin" which is squeezed by an upper and lower plastic die and then stretched. This one operation saves more than 3½ hours per part.

Plastic tooling has been developed almost entirely within the aircraft industry, a situation created by critical shortages and the urgency of production. However, it is flexible enough and has such vast possibilities that it can be adapted to many manufacturing processes. It is revolutionary in that it simplifies the duplication of curved surfaces. In addition unusual shapes can be developed in plaster and then reproduced in tough phenolic for the production run. Currently, the Plaster Patterns Department at the Buffalo plants is a vital part of the plastic tooling group.

It has only been within the last few years that the plaster method of creating patterns has been developed to its present state of perfection. As a means of rapidly developing patterns it is unsurpassed since the patterns are developed from original loft lines, lofting templates or mockups.

To illustrate the speed with which it is possible to produce a part with the aid of plaster patterns and plastic tooling, the following is given as a typical operation:

The project is to produce in one part the dorsal fin which joins the fuselage to the vertical stabilizer on the *Commando*. This had previously been made from a right and a lefthand piece, and produced with draw-dies. These parts required considerable fitting and supplementary

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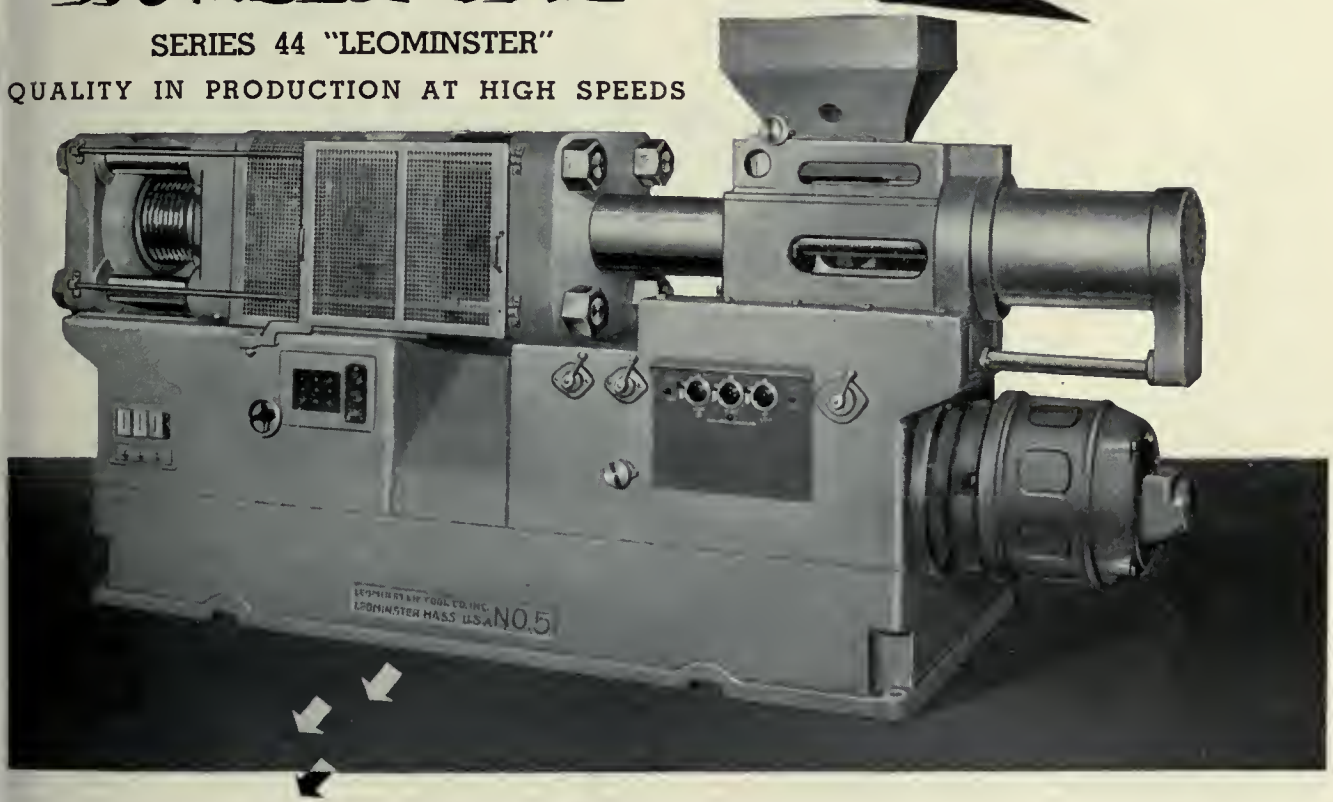

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drill jigs to prepare them for installation on the fuselage.

The Plaster Patterns Department obtains a series of metal templates which represent the correct contours at a representative number of locations or "stations" on the airplane itself. These are placed in their proper positions on a marble-top table and braced rigidly by wood held in position with plaster. The voids between the metal templates are covered with burlap near the top, allowing only sufficient depth of plaster to provide a rigid foundation on which to work. A mixture of plaster and jute is then used to fill in the voids above the burlap and as soon as is practical, the working surface of plaster is applied and worked to the correct contour using the tops of the metal templates as a guide. This gives an exact reproduction of the surface to be produced, with due allowance for the shrink of the material from which the finished form will be made—in this case, plastic. This completes the first step.

A plaster mold then made over this form and when hard it is removed, dried and given a coating of acid-resisting paint followed by an application of hard wax. It is now ready to receive the resin.

The resin is made ready and poured into the form, properly cured and removed from the mold leaving the mold intact. This plastic form is an exact reproduction of the original plaster contour, only slightly smaller due to the anticipated shrink. It is surprisingly smooth and requires only minor touch-up after which it is mounted on a proper wooden backing for attachment to the stretch press. It is then ready for installation on the press.

Not only is the original tooling cost a fraction of the former cost, but production and assembly has been greatly simplified as well.

Other Interesting Applications

In addition to the hydro-press draw-dies and stretch press forms, a number of other interesting applications have been developed at Curtiss-Wright, such as checking fixtures, router forms, electro-plating shields and parts of production fixtures, where again the stable nature of the material is a major consideration.

As an illustration of the last mentioned application, a plastic beam has been a part of a side cowl assembly and drilling fixture for the past eleven months and during that period has not varied 0.002" in length. It replaced a part made of a zinc alloy and was tried as a substitute for a steel part which would have cost more than ten times as much as the phenolic casting. It was also one of the numerous experiments which have been carried on in the interest of establishing dimensional stability and in this instance it proved highly satisfactory.

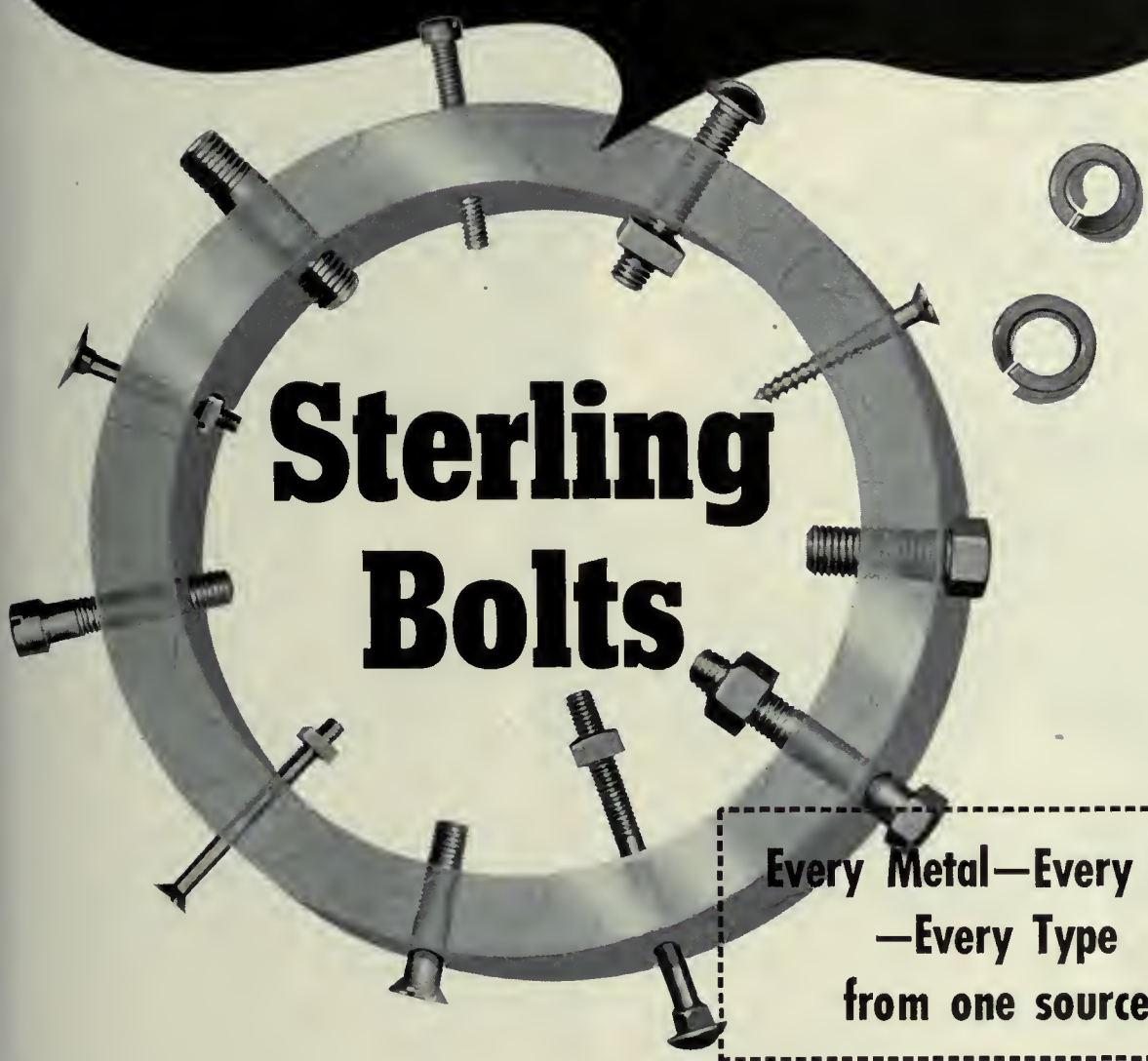
It has increased from a material which had relatively low physical properties to one which has a published compressive of 33,000 psi and laboratory samples are as high as 44,000 psi compressive, 18,000 psi tensile, 122 Rockwell, "B" scale, ⅛" ball, 60 Kg and still going up! There are more types of plastics than there are alloys of steel—even now!

Like steel, it has been oil tempered, case hardened, and heat-treated, and from present knowledge it is established that a wide variety of materials can be conditioned to suit particular requirements in tooling where the factors of time and cost are of major importance.

Curing plastics by short wave diathermy is beyond the first experimental stages and it promises the means of greatly reducing the time element in the present curing process as well improving the product.

The existing record of definite applications point to a marked improvement in the plastic process. END

for Fastening Plastics



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To help you with your plastic fastening problems, the Sterling Bolt Company offers two-fold assistance:—a fastening consultation service and one source of supply for all your fastening requirements. For many years our fastening experts have been successfully and economically solving fastening problems for the plastic and other industries. Our bolts, nuts, screws, rivets and washers are of every size and type, accurate, uniform and economically efficient for every fastening purpose.

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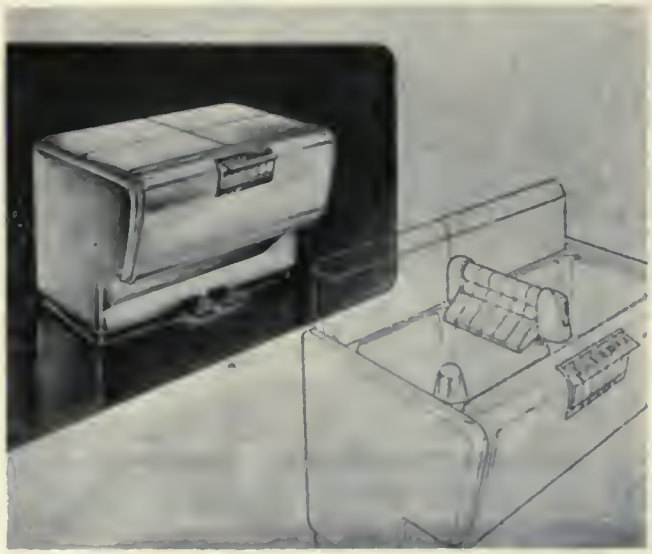
Merchandising Plastics Through TELEVISION

MODELS OF POST-WAR PLASTICS PRODUCTS TO BE DEMONSTRATED BY PROMINENT U. S. DESIGNERS



A plastic washing machine with push-button control will automatically perform all washing, rinsing and drying operations

This plastic and stainless steel luncheon set is designed to embody the characteristics of plastics along with increased usable area

TELEVISION may prove to be one of the most powerful forces for merchandising plastics. In presenting plastic wares to the public, the shining beauty of the material is its most attractive asset. All advertising will have to be visual to be most effective.

At present, magazines and catalogs can show plastics products in almost natural colorings while television in black and white is at a distinct disadvantage, however, the researchers in television development promise future telecasts in full color. But, even without color, television can present powerful sales arguments.

The amazing qualities of plastics can be shown in moving demonstrations on the television screen. In one minute a man can tell more by stamping heavily on an object and then displaying it unharmed than by saying it is unbreakable in a thousand words. In a telecast play, someone might drop a lighted cigarette on plastic upholstery and thereby seal the idea of flameproof materials, or ink might be spilled on what appears to be a fine leather desk and wiped off completely in a convincing demonstration of soil-resistant plastic "leathers."

Television broadcasts can be both interesting and educational. Even in a purely fictional drama, the background may incorporate the use of a new product. And the development of plastic in itself is so dramatic that semi-technical discussions can hold the attention of the layman. Through such lectures the public can be instructed and in turn may originate many ideas.

Probably the first to use television as a merchandising medium is the Durez Plastics & Chemical Company. Their telecasts over station W2XWV are of particular interest to the whole industry because each week a leading industrial designer forecasts the shape of shoes and ships and sealing wax in the post-war world.

The half-hour program on Sunday is called "Your World Tomorrow." It includes a preview of "things to come" by such top-flight experts as Walter Teague, Egmond Arens, Raymond Loewy and a score of others. These experts demonstrate and describe the plastic and electronic wonders being readied for the period after the peace.

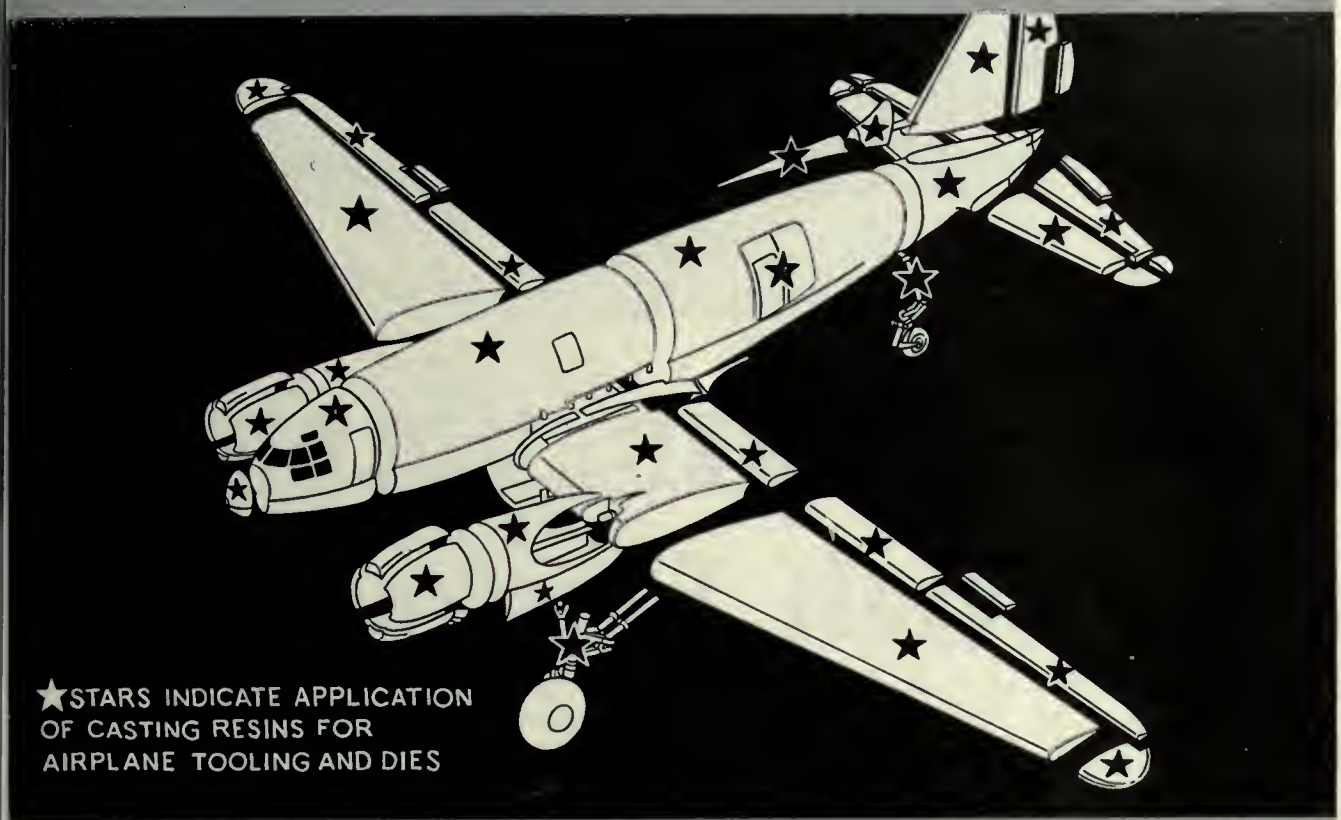
Each program opens with a five-minute discussion of current developments in design which have peacetime applications. The commentator reports on the newest discoveries in the field of plastics and its associated industries—chemistry, electronics, housing, transportation, aviation and housewares.

Special studio preparations for this television series include a plastic backdrop and revolving stage. This set-up offers another market for plastics.

The Television Workshop prepares numerous props for telecasts using many plastics for full sized and scale models of post-war homes. Many design innovations will spring from visual impressions the public will get from these backgrounds. Realistic models of advanced conceptions of cars, planes, ships, washing machines, refrigerators, and almost everything Mr. and Mrs. America want have been seen in telecasts.

The Durez Company, in cooperation with leading industrial designers, has been the first to thus educate the future users on the unlimited possibilities of the synthetics. Other companies may soon follow suit and use this new medium to firmly implant the advantages of plastics plus a sound desire for them in the minds of those who will shape future merchandise by their buying. END

MARBLETTE CASTING RESINS *SPEED* SHEET METAL FABRICATION!



★STARS INDICATE APPLICATION OF CASTING RESINS FOR AIRPLANE TOOLING AND DIES

You Can Do It Quicker, Better, More Economically with

PLASTIC TOOLING and PLASTIC DIES

★ In worplane manufacture, from "prop" ta rudder — fram wing tip ta wing tip, Marblette Casting Resins affer a lagical solutian far the multitude af prablems which each day canfrant praduction engineers building America's air might. Here are same ideas for the applicatian af Marblette Costing Resins:

★ Marblette Casting Resins can be widely used in the develapment af punch press and mating dies; drill and assembly jigs; form blacks; fixtures far spot welding and riveted assemblies; rubber press dies; blacks far farming acrylote sheets as well as for routing fixtures and many ather uses.

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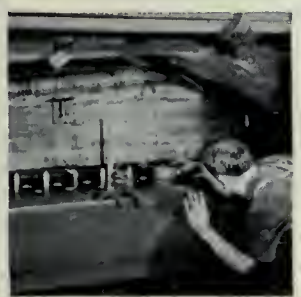

A large plastic die, mounted an waaden base, accurately forms aluminum sheet inta an impartant section af airplane engine cowl.

Let us tell yau haw the advances made in worplane praductian taaling and dies paint the way ta mass-praductian shart-cuts far general industry.

Marblette offers its laboratory facilities, its technicians and its products for the development of efficient dependable mass-production tooling and dies, not only in the field of aviation, but wherever the use of casting resins seems indicated to speed vital war manufacture. Call on us without obligation.

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Fairchild "Gunner" covered with Duramold processed plywood

LOW PRESSURE MOLDING for Aircraft Construction

By Arthur W. Loerke

Chief Engineer, Duramold Division
Fairchild Aircraft & Engine Corp.

WOOD LAMINATES WITH PLASTICS BONDS PRODUCE LIGHT-WEIGHT, HIGH-STRENGTH STRUCTURAL MATERIAL

PLASTIC airplanes have been subjected to all sorts of criticism. Even after the famous *Mosquito* left its vicious sting in the Luftwaffe it was called a "wooden crate." Careful examination of the facts upon which most of this criticism is based shows that it was not the use of plastics which deserved the criticism nor even the wood used in combination with the adhesives, but the faults were in the materials and methods of bonding the pieces of wood together, and the finishes for protecting the wood.

It is a simple fact that no material is more durable in an assembled structure than the joint which fastens the pieces together. Therefore, the tremendous advantages of molded plastic airplane structures could not be realized until efficient methods could be developed to bond intricately curved laminates inseparably together.

About six years ago, the Fairchild Engine & Airplane Corporation started investigations of possible substitutes for aluminum and specified a material which: (1) could be molded and fastened together with adhesive, thereby eliminating the then high cost of joining aluminum by riveting, and (2) would have about the same strength-weight ratio as aluminum and yet have a low enough density to provide sufficient local rigidity to insure structures which would have a perfect contour and a smooth surface. This sleek contour requirement is not met by even flush-riveted aluminum structures, yet maximum smoothness is of such importance that practically all aircraft manufacturers have gone over not only to flush riveting but to extreme methods of smoothing of flush rivets, and even to waxing them. While these constructional and processing refinements in metal may give what appears to be a surface of perfect contour, in actual operation these surfaces become wrinkled under stress with consequent loss in performance. A *Spitfire* is said to lose 23 mph just because of the increase in the roughness of the wing surface with use.

Skin Friction Losses

Every minute ripple or blemish on the skin of an airplane takes its toll of speed and range, because of the terrific drag and the loss of lift caused by a turbulent flow over the airfoils. These skin friction losses can be minimized in metal airplanes by adding more supporting structures and using thicker surface aluminum than is required to carry the load. Such expensive weight-increasing measures do not eliminate the countless irregularities of the finest riveting, nor do they strike at the real root of the problem, which is to obtain a material of low enough density to provide the required *load* stiffness without excessive weight or manufacturing expense.

While wood has been available for years as a low density material and has been used both in the solid and plywood form, it was not until the latter part of 1936 that methods were available for producing double-curved multi-layer "shells" of veneers with completely durable bonds between layers, and between the edges of joined strips comprising each layer. In the pioneer work in

Plastics
PROCESSING MACHINERY

LABORATORY MILLS

for sheeting, milling and breaking down plastics material

MEETING the need for small mill production and experimental batches of materials, in both rubber and plastics, the EEMCO Laboratory Mill is an entirely enclosed unit complete with motor and variable speed drive, ready to operate. No specially built foundation is needed—therefore reduced installation costs are possible. Write for folder BR1.

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for molding plastic parts

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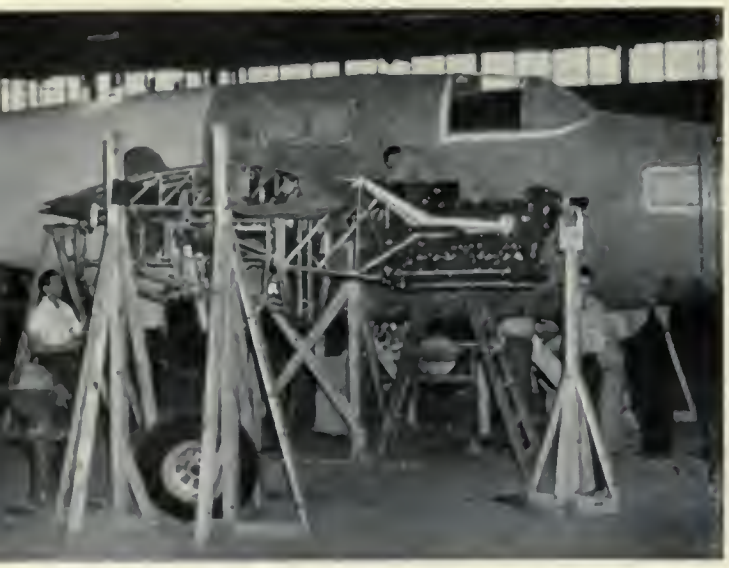
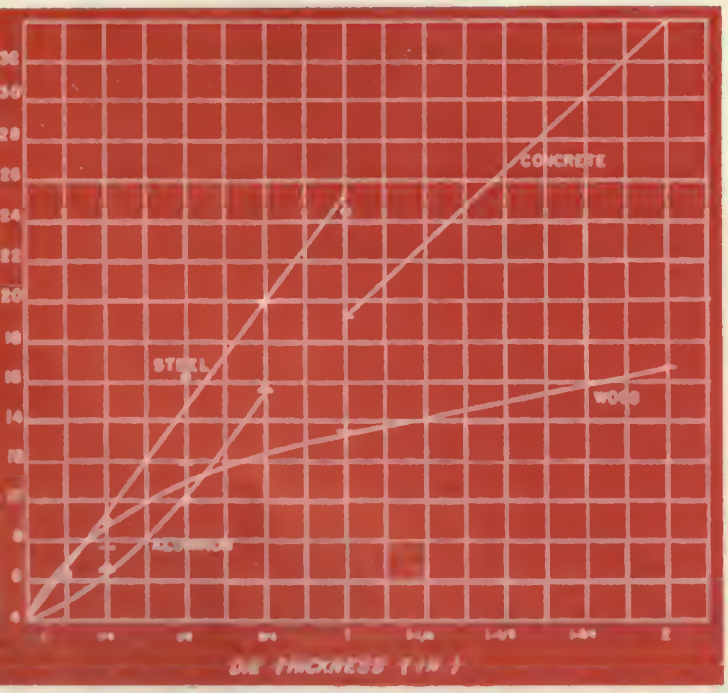
aying up veneers in the mold for a half fuselage section of the "Gunner"



'ith the aft fuselage section joined, the airplane nears its final assembly



ect of die material and thickness on time required for coldest glue e in 3/16" material to reach temperature required to set phenolic at 280° F

wood laminates for airplane structure, a wet adhesive necessarily was used and this expanded the strips or veneers so that when they dried, gaps of varying width appeared between the joined strips making up the assembled shell. To cover over these gaps and to protect the adhesive from the effect of moisture, a fabric cover was "doped" on. Today this practice is still used in modern planes assembled with casein adhesives such as the De Havilland *Mosquito*.

Permanent Moisture-Tight Bond

The Duramold process was developed to overcome the early difficulties in producing a perfect shell. It provided a structure in which the laminations were held tightly against each other at the edges of the strips making up the laminations. These strips were bonded together with a completely weather-resistant adhesive. Naturally, this had to be done with a dry adhesive, and while there was some data on the technique of using such dry adhesives for flat panels, none was available for *double*-curved shells. The construction of commercially feasible dies to withstand temperatures up to 280°F and pressures of 80-100 psi on a surface of 125 sq. ft., a total pressure of over 875 tons was not an easy task.

Control Factors

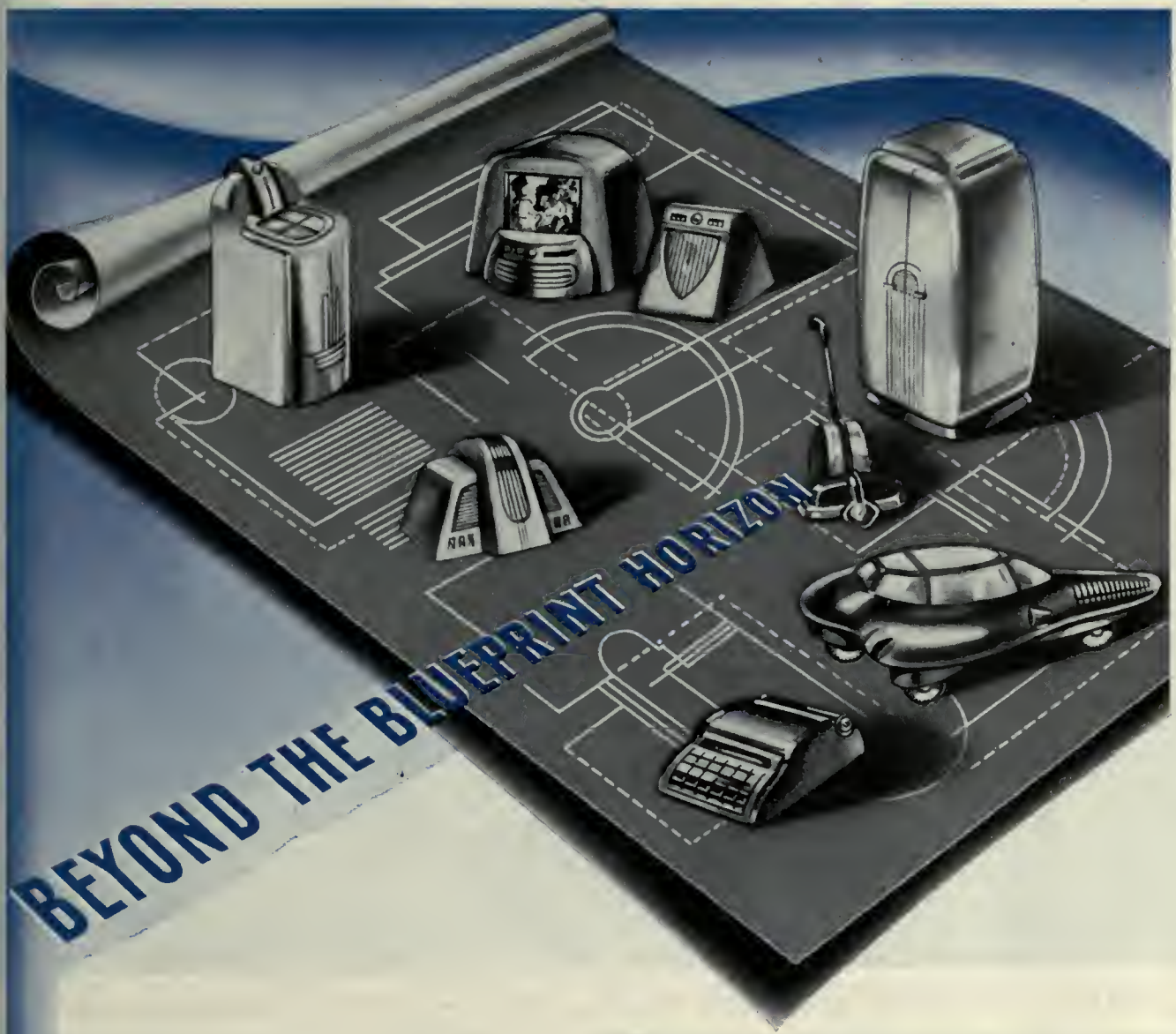
While this molding process is now a standard manufacturing operation, it nevertheless requires accurate control, both as to the temperature and pressure, and to the minute-by-minute relation between the two. The thermosetting adhesives go through successive stages of becoming plastic—increasing in plasticity to a point where the resin becomes a viscous liquid, then losing plasticity in finally setting. If pressure is applied while the resin is too liquid, the plastic goes into the wood, causing starved joints, while if the pressure is applied too slowly the resin may have become so thick that it does not penetrate enough for a perfect bond. The liquidity can be changed in the original formulation and in the temperature pressure relationship. The proper time, pressure and temperature relation and methods of controlling them are requisites in production as well as in the original formulation in order to obtain a uniform result.

In other processes efforts have been made to reduce the temperature and the pressure required through the use of certain thermoplastic adhesives. While such attempts simplified the manufacturing process, they did not produce the most durable product or provide manufacturing methods suitable for large, complicated elements.

Thermoplastic adhesives are ideal to the extent that they can be applied, allowed to dry and then resoftened through reheating. These thermoplastics set on cooling and, therefore, pressure has to be maintained until the parts are cooled. This requirement involves provisions for maintaining pressure during that part of the cycle. If a mistake is made it can be corrected by reheating, an advantage not found in thermosetting resins. However, at temperatures to which modern airplanes may be subjected in service, these thermoplastic adhesives have more or less what is known as cold flow—that is, the tendency of one part under stress to slide slowly on the other, a characteristic most undesirable in an airplane structural material.

True, some of the more modern thermoplastic adhesives have less cold flow than others, but it is sufficient to make their use in aircraft structures questionable. Research is continuing and this tendency to cold flow may be reduced in the future to a point where new thermoplastic adhesives may be useful.

While low temperature thermosetting resins (such as the low temperature urea resins setting below 200°F) have advantages from the standpoint of reducing the skill re-



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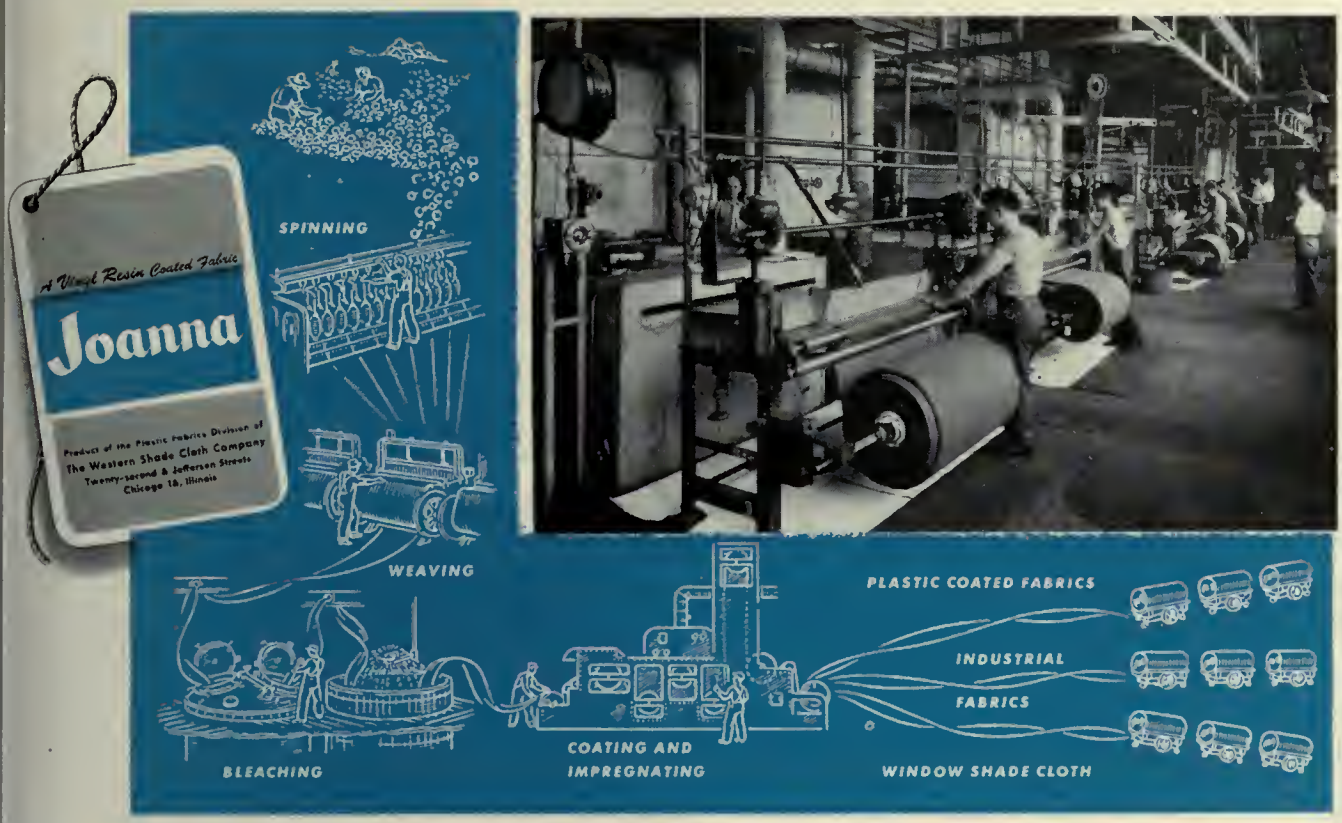
Sealed under a rubber blanket, the fuselage section is rolled into an autoclave where it is subjected to combined heat and pressure

Fuselage shells ready for wings and tail sections

quired in processing, they have disadvantages which practically eliminate them from consideration for the manufacture of large, complicated structures. All low temperature adhesives have to be put on and pressure applied between the parts within a short time, usually in less than an hour, for the reason that the necessary setting reaction is obtained from a catalyst instead of heat. It is obviously impossible, without a prohibitive number of workmen, to lay carefully all the strips of veneer in a large complicated die and obtain the required pressure before such low temperature adhesives set. Pressure for such low temperatures must be obtained with a vacuum, heated air, or hot water, since steam does not generate pressure below 212°F. It is not practical to obtain much over 30 lb. pressure in autoclaves by air and vacuum, and the pumps and fluid transfer tanks for large dies add more complications than they eliminate. Considering the process as a whole; 30 lb. pressure is too little to compress veneers of much curvature into the contact required for durable joints.

It is important in low temperature adhesives to have a thin line of adhesive if later crystallization and loss of strength in the joint is not to occur and this, except for pieces of low curvature, requires pressure greater than can be obtained with compressed air or vacuum without excessive cost. At best, low temperature urea or melamine resins, while providing joints far more durable than



PLASTIC COATED FABRICS may play an important part in your plans for the future

When industry again turns to peace time pursuits there will be a heavy demand for many kinds of fabrics "*multi-proofed*" *with plastics.*

Vinyl resin coatings are here to stay. Called upon, after Pearl Harbor, to pinch-hit for scarce, conventional fabric proofing materials, they have performed superbly under most difficult conditions. For hundreds of applications they have permanently replaced the protective materials for which they were substituted.

Coating fabrics with plastics is nothing new to our organization. Long before Pearl Harbor, it was an accomplished fact. With a background of nearly half a century of fabric coating experience we were among the first to master the difficult technique of applying plastic coatings to cottons, silks, rayons, nylons, ducks, burlaps and paper.

Chances are that somewhere in your post-war operations you will use to good advantage some type of fabric coated or impregnated with protective plastics.

You, for instance, may be a manufacturer of items for consumer sale such as luggage, furniture, books, rain wear, shoes, shower curtains, garment bags, baby carriages, mattresses — or —you may be a manufacturer of heavy goods such as railway coaches, airplanes, automobiles, trucks, refrigerators, etc. If yours is a fabric problem, we believe we can supply the answer.

Our research and manufacturing facilities are now devoted largely to the production of fabrics for our armed forces and essential civilian uses. When production can be safely diverted from these essential requirements, our entire facilities will again be at your service.

Joanna Coated Fabrics

PLASTIC FABRICS DIVISION

The Western Shade Cloth Company, 22nd & Jefferson Streets, Chicago 16

Plastic Fabrics Division: VINYL RESIN, PYROXYLIN AND OTHER PLASTIC COATINGS • PROOFED FABRICS AND PAPERS • SIMULATED LEATHERS
Industrial Fabrics Division: RUBBER HOLLANDS • VARNISHED SEPARATOR CLOTH • BOOK CLOTHS • AND OTHER SPECIALIZED FABRICS
Window Shade Division: WINDOW SHADE CLOTH, ROLLERS AND ACCESSORIES • CLOTH AND PAPER WINDOW SHADES

JOANNA TEXTILE MILLS, GOLDVILLE, SOUTH CAROLINA

The Story of

A BUTTON AND...

Your Peacetime Business

We've got a million of 'em . . . a million unimpressive little plastic buttons. They've got an eagle on them and a semi-circle of tiny stars. But they're dull, lack-lustre, unglamorous. They'd be a disappointment on the jacket of any fighting man.

But, wait . . . !

As we dig into 'em—put them thru the mill —they change. The dull little button takes on an armor-plate of shiny gold. They gleam a defiant challenge to the Nazi horde. They're ready now to dress the uniforms of a gallant ally's military force. That's their wartime role.

But they hold forth a promise of wonderful things to come in the peacetime world. . . .

To the novelty industry, costume jewelers, button manufacturers and creators of women's wear, the Cohan-Epner Co. ingenuity will bring new brilliance—new high standards of merchandise. We are not producers of the base materials but we can finish them in many amazing ways. Aggressive manufacturers will want to discuss how our many and varied finishing processes can be utilized to increase the salability and profit margin of their products. We will welcome the opportunity to plan *ahead* with them.

METAL DEPOSITING ON:—
Celluloid — Bakelite — Catalin — Plaster — Rubber — Fabric — Glass — Wood — Cork

METAL FINISHING OF:—
Chromium — Cadmium — Rhodium — Copper — Bronze — Silver — Nickel — Brass — Gold — Zinc — Tin

POLISHING GRINDING
BARREL PLATING
SPRAYING ACID-DIPPING

COHAN-EPNER CO.
INCORPORATED
142 West 14th Street
New York, N. Y.

casein adhesives, nevertheless are not as durable as those made with the high temperature phenolic adhesives.

Low Pressure Laminates Differ

Plywood of the best grades is made from wood veneers and plastics bonds. In plywood, the pressing is done between two rigid platens, and in the bag molding processes between one rigid and one flexible die, or platen. In molding pieces from a large number of veneers, the unequal densities from point to point in the veneers must be taken into consideration. Thus, in the assembled pile there will be low spots and high spots under pressure.

In making plywood between two rigid dies, two approaches are possible. The first is to apply sufficient pressure to the rigid dies to bring the low spots into contact with pressure. This means crushing some of the fibers at the high spots. The other approach is to use less pressure to eliminate crushing of the fibers. In this case the low spots do not have the pressure necessary for a perfect bond. By the use of one rigid platen and one flexible platen and fluid pressure, the entire piece is molded with sufficient and uniform pressure at the glue line irrespective of the inequalities in local thickness of individual veneers. When curved or double-curved parts are considered, the difficulties of getting a substantially uniform pressure without crushing the veneers is aggravated. It is here that bag molding processes have the advantage and produce a result different from conventional plywood.

When the problem of making parts such as half of a fuselage was presented, it was evident that the total pressure on the rigid platen would be of the order of 200 tons and this would involve heavy and expensive dies. By enclosing the die and part to be molded in a bag and placing the assemblage in a tank under pressure, the forces on the die became those of compression alone and by this means the die cost was greatly reduced. Unfortunately, solid dies first used were not capable of conducting heat and therefore, all the heat had to come through one side of the material in the mold from the rubber bag.

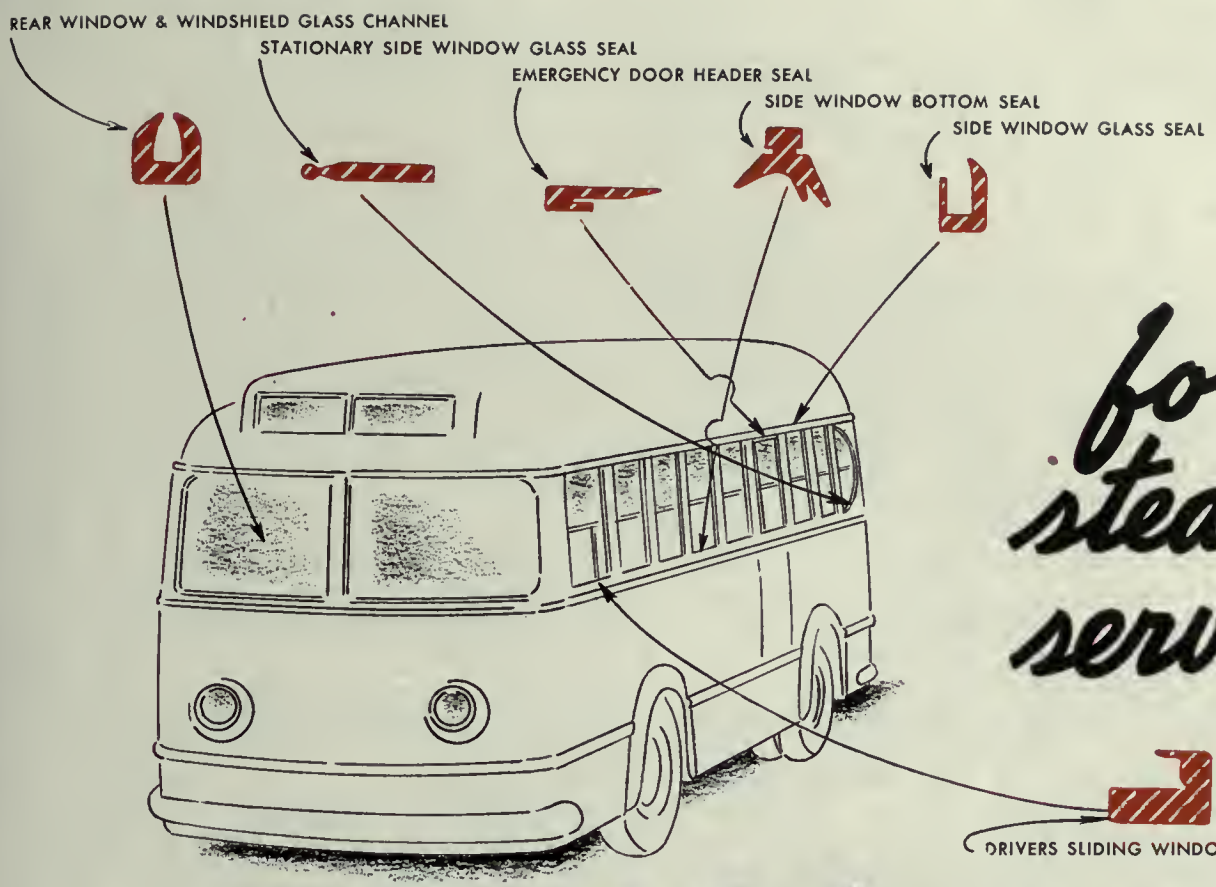
Having the heat come from one side only was not a great disadvantage for small pieces (not over ⅛" thick) but for thicker pieces the time to set was lengthened to such an extent that cost of processing was appreciably increased.

Blanket Replaces Bag

The solution was to use a thin heat conducting metal die in place of a solid form of wood or other material in combination with a blanket which could be sealed at the edge of the die. This heat conducting metal die member and the rubber blanket brought heat to both sides of the part being molded, and cut the molding time more than one-half. In addition, by the elimination of the bag and the substitution of a blanket, large dies became practical. For ease in handling, these large dies could be welded to a framework and the whole mounted on casters in order to be easily moved to the tank from the room where the material was laid against the die.

This method offers a two-fold saving in precious rubber. First, the blanket need cover only one side of the piece to be molded whereas the bag must not only cover both sides of the work, but it must also have enough extra material to completely cover the die too. And the second big saving in critical rubber comes from the reduction in time that the piece is in the tank. This shorter exposure to the steam in the tank, plus the fact that the blanket can be handled with much less wear and tear, can be translated into longer wear and savings per cent per pound

(*Continued on page* 95)



for steady service

Macoid Extrusions

Other examples of MACOID extruded elastomeric plastics in our special Vinyl compound, MACOID 320, are these applications on the Dearborn Coach Company's bus.

MACOID 320 has the feel of rubber, but is much superior to the natural product in resistance to oil, greases, gasoline, acids, alkalies, etc. Profiles are extruded to specification of manufacturer, Ford Motor Company.

So satisfactory is this material that many automotive designers are specifying it for their postwar models, even should natural rubber be available.

As originators of modern dry plastics extrusion, MACOID has been privileged to initiate many applications of the process, and to develop special formulations of materials. We will be glad to serve your requirements with special profiles and materials whether you are in the automotive field or the other fields we serve. We also do injection molding.

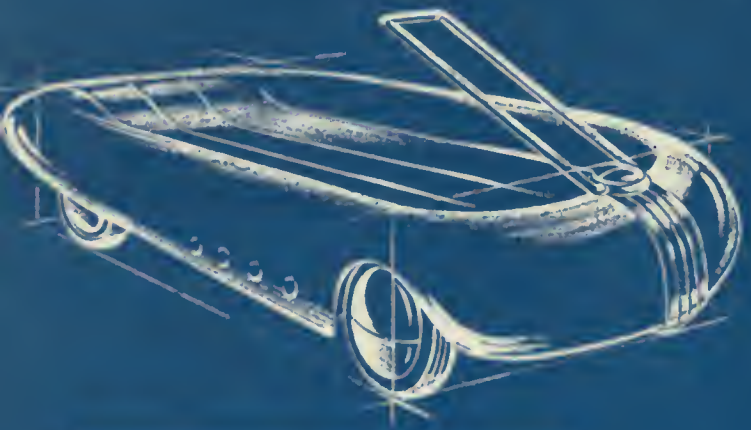
DETROIT MACOID CORPORATION
12340 Cloverdale Ave.
Detroit, Michigan

ORIGINATORS OF DRY PROCESS PLASTIC EXTRUSION

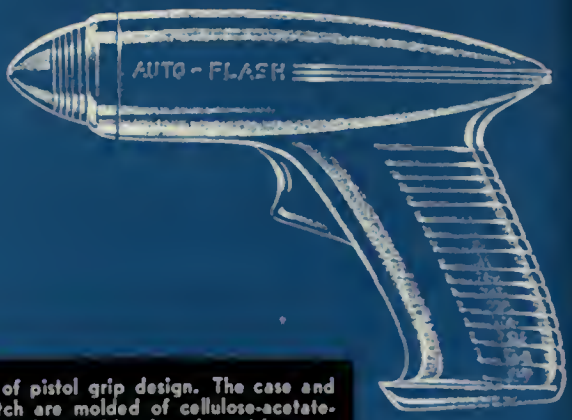
ON THE DRAFTING BOARD

Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

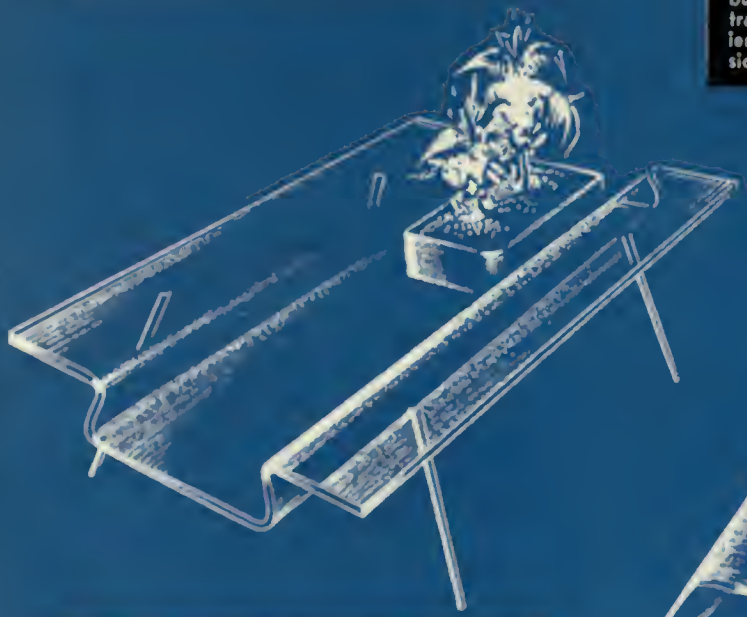
PLASTICS welcomes designers' contributions to On the Drafting Board.



Child's coaster wagon of monocoque construction fabricated in low-pressure molded, plastics impregnated laminate. Sturdy, light weight, non-rusting and dentproof. Low tooling cost is a production advantage that will reflect in the price. *By Dohner & Lippincott, New York.*

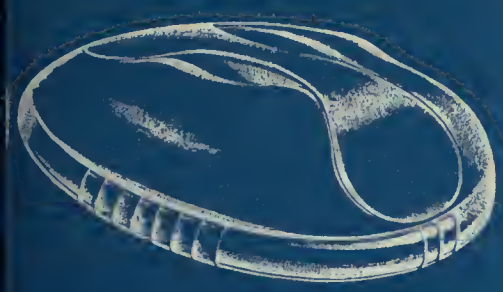


Flash light of pistol grip design. The case and trigger switch are molded of cellulose-acetate-butyrate in a choice of bright colors with a contrasting color for the switch. Shatter-resistant lens of clear cellulose-acetate produces some side lighting. *By Dave Chapman, Chicago.*

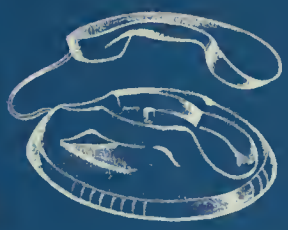


Decorative table. The top is formed of transparent methyl methacrylate sheeting. The legs are cut from rod stock of the same plastic and attached by a process to provide "invisible" joining. The table may be of clear or colored transparency. *By Bartolucci-Waldheim, Chicago.*

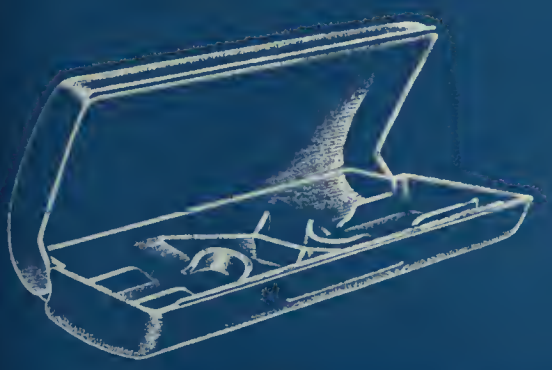
Chair of body fitting design. Low pressure molded of impregnated laminate, a technique especially suitable to furniture fabrication. Adaptable to a variety of new surface finishes, it is light weight, yet of strong "one piece" construction. *By Dohner & Lippincott, New York.*



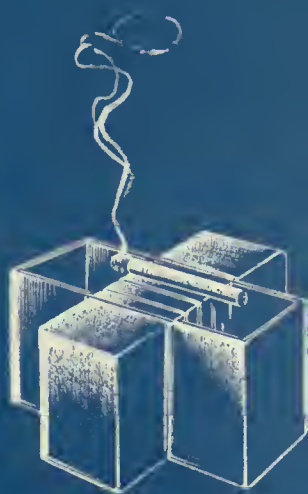
Flush design of cradle type telephone for home extension. It is light in weight and convenient for carrying from room to room. Tha cord is retracted on a concealed spring winding spool. A choice of colors. Transparent button is illuminated. *By James M. Hart, Detroit.*



Shatter-resistant window of methyl methacrylate affords desirable admission of ultraviolat rays of sunlight and good light transmission with raduced raflaction. Slanted mounting providas for "self-washing" in rain. *Design suggested for post-war homes by Bartolucci-Waldheim, Chicago.*



Denture case molded of black polystyrene. A convanient itam to provida sanitary overnight anclosure for dentures. "Catch" lip on lid holds it closed for carrying in luggage for use in travaling. *It was designed and modeled by Achille G. Bureau, Long Island, N. Y.*



Novel combination of card case and ash tray molded of phanolic. The two interlocking pieces being identical, only one die is needad for the molding of both halvas. A pramium item for gift and advertising purposes when materials are available. *By Guy W. Hodges, New York.*

This plastics portable radio is a taste of tha distinctive design which will be typical of post-war home dacorativa styling. Dasigned for monotone color or contrasting color combinations. Tuning dials and switch are integratad in the top piece. *By Dave Chapman, Chicago.*

CAPITAL Report

By Arnold Kruckman

Plastics' Washington Correspondent

THE most important news specifically affecting the plastics industry is the promulgation of the new Plastics Products Price Ceiling Order, MPR 523, published on March 27, and circulated early in April. This is the document upon which S. S. Ullman, Plastic Specialist of Parts and Subassembly Section, Machinery Branch OPA, has labored for over 8 months. Its accomplishment is conceded to be one of outstanding achievements by the Government devoted to business. In bringing together the multifarious details and interests involved, Ullman had to cut across many different parts of Government, interview many sections of the industry, and hold many conferences with industry advisory committees, officials of Government, members of the armed services, and the conspicuous figures in Washington who make policy. The eight page Order embraces price-making for everything produced by or for the industry except raw materials. It covers end-use products as well as parts.

Obviously it is so far reaching in its implications that it will need elucidation; and some of the explanations will be supplied in an article which Mr. Ullman, author of the Order, will prepare for the next issue of PLASTICS. Mr. Ullman is apprehensive that the usual "horseback" analyses which might be supplied by those who have only casual acquaintance with the Order may be misleading. He urges that those who are interested should send to him directly for a copy of the Order and study it in detail. Address S. S. Ullman, Plastics Specialist, Parts and Subassembly Section, Machinery Branch, Office of Price Administration, Room 6232, Federal Office Building, Washington, D. C. He hopes study will prompt those interested to write him for further explanation of angles that may not be quite clear to them.

Plastics Products Pricing

The general outline provided by Mr. Ullman, in the Government release, meanwhile is probably the most intelligible covering statement:

"Plastics manufacturers, who often found it necessary to refer to provisions of three different regulations in establishing maximum prices, have been provided with a single regulation covering all plastic products. The new regulation establishes prices for manufacturers' sales of plastic products, and dies, molds, and special tools sold in connection with sales of plastic products, at March 31, 1942, base levels. Since this is not a later base price date than those in the regulations formerly governing manufacturers' maximum prices, present price levels will not be affected by this Order.

"Because plastics producers do not confine their production to a definite line of commodities, confusion resulted to the industry in pricing different items, as prices were formerly established according to the use of the finished article. It was difficult, therefore, for manufacturers to determine which provisions of any one of the three regulations formerly governing manufacturers' maximum prices were applicable.

"In addition to simplifying manufacturers' pricing problems, the regulation will also permit consideration of problems particularly related to the plastics industry. The frequent substitution of one plastics material for another, and the adoption of the use of new plastics materials, are examples of these problems."

For plastics products sold or offered for sale from January 1 to March 31, 1942, the new regulation provides that manufacturers' maximum prices will be first applicable:

1. The manufacturers' published list price of March 31, 1942, less all discounts, allowances, and any further deductions from that list price to a purchaser of the same class on that date.
2. The last price at which the manufacturer sold or offered to sell the product from January 1 to March 31, 1942, be adjusted to reflect the manufacturer's March 31, 1942, differential between the class of purchasers to which that sale or offer was made, and the class of purchasers to which the present sale or offer is made.

In the case of plastics products which were not offered for sale by manufacturers during the period January 1 to March 31, 1942, the maximum prices are to be established thus:

1. If the manufacturer has a March 31, 1942, pricing formula, this formula may be used in establishing a price for the new product.
2. If the manufacturer did not use any price determining method for plastic products March 31, 1942, he may submit to OPA for approval a proposed pricing formula. This formula will be examined by OPA to determine if it is consistent as possible with costs, returns, and other factors prevalent in formulas established on the base date. Sales may not be made for products under new formulas until written approval is given by OPA.

In cases where the manufacturer purchases the die, mold, or special tool for resale in connection with the sale of a plastics product, he must not charge more than the price he paid for the article, which price, of course must not exceed the applicable maximum price.

Where the plastics manufacturer produces the die, mold or special tool, his maximum price will be the current total unit cost of the article.

Fifteen products and commodities are excluded from the Order:

1. Cellophane products (regenerated cellulose).
2. Completed consumers' articles when sold by a person who is not engaged in molding or fabricating plastics materials.
3. Electrical transcription and direct writing records.
4. Fabricated parts under .002" thickness made from sheets of ethyl cellulose, regenerated cellulose, and cellulose acetate.
5. Fabricated pieces under .010" thickness for use in window envelopes.
6. Impregnated and coated fabrics, paper or leather, and products produced therefrom. This exclusion does not apply to laminated parts.
7. Motion picture, photographic and X-ray film.
8. Plastic-plywood products.
9. Powders, granules, liquids, preforms and scrap material.
10. Protective or decorative coatings.
11. Safety glass.
12. Sheets, rods and tubes, prior to fabrication, when produced by a manufacturer who sells molding compounds produced by him.
13. Synthetic rubber products.
14. Vulcanized fibre sheets, rods and tubes, prior to fabrication.
15. Secret war contracts.
16. Developmental contracts.

MPR 345 was amended March 27 to cover thermoplastic scrap, providing a method of establishing producers' prices

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for sales of scrap composed of non-plastic materials which are laminated with vinyl compounds. The amendment is designed to make possible selling of the scrap for reprocessing to recover the vinyl compound plastics. Price per pound is based on the weight of the vinyl compound in each pound of scrap. The weight is reduced by 10% and multiplied by the established price of the particular vinyl compound, or mixture of compounds, in the scrap. Purchasers thus have 10% margin for extracting the vinyl and selling it. Considerable quantities of non-plastic scrap is available. Navy is now producing more than 100,000 pounds per month of scrap cable covering made of fabric coated with the compounds. Large stockpiles of scrap accumulated. Navy requested a maximum price be established.

MPR 519 fixed price ceiling for laminates used in a variety of products such as electric equipment, airplane pilots' seats, airplane doors, gears and pulleys, wheels, and many other items. It was issued in March.

Manpower

Government people frankly say the plastics industry, from raw materials to the end-product, will be hit hard by the drive to squeeze manpower for the armed services out of the civilian industries. War industries as well as purely civilian industries will be stripped of young men. The armed services need men, and more men, and only the key men in the most critically important indispensable jobs will be left untouched, even in war industries. The plastics industry at every level is largely made up of young men. In the current sense it is a new industry, and its identification with young men is logical, even if it is tough on the industry under war manpower conditions. Even though government realizes that approximately half the workers in the industry already are women, Selective Service feels the industry must take on more women and over-age workers. It is suggested by government people here that it is not unlikely 80% of the workers will be female by the time the war reaches its climax.

This hint should be valuable to those who are responsible for the industry operation. Able bodied men in or out of war industries will unquestionably be taken as swiftly as the processes of the draft can work. Those between 18 and 26 will go between now and July 1. Those in the brackets between 26 and 30 are being screened now and will be entirely combed out by September 1. If there is no less need for more reserves in Autumn, those between 30 and 35 will then be inducted wholesale. With rare exceptions, the only reasons for deferment are age and physical disability. The reason for the abrupt demand for more men is a shift in policy to the use of more infantry. You are expected to find the men you need for the heavy work in the 4F classifications.

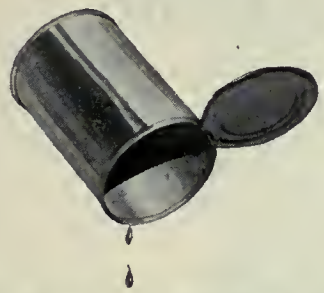
WPB Allocations Orders

The Order expected from WPB, revoking L-159, Plastics Machinery, was still log-jammed in the Bureau of the Budget, in April. This is the final step in processing new Orders or revoking old ones, and usually takes time. At this writing it is unknown whether it will be promulgated within a week or within a year. There is considerable discontent in WPB over the delay. The revocation of L-159 will place plastics machinery under Machinery Order M-293, the all-inclusive machinery order. Neither molds nor used machinery will come under M-293. Forms will be provided for applications to obtain new machinery, and when the application is approved a specific delivery date will be indicated. The new arrangement is expected to facilitate many slow motion processes now causing discontent in the industry and in Government.

Order M-154 was amended in March to prohibit the use of more than 50 pounds of nitro-cellulose plastic in any month to make for civilian use: advertising specialties; amusement machines and parts; animal feeding dishes and cups; artificial flower pots, flowers, florists' supplies; badges, emblems, campaign buttons, but not those used for government or in war work; bill folds, book covers, book ends, book marks, book stands; buttons and buckles; calendars; caskets; clothes hangers, hat stands, shoe horns, shoe trees, tie racks; coin banks, coin holders; crumb scrapers; curtain fixtures and window pulls; advertising display articles; furniture and parts; greeting cards; handbags; handbag frames; hats and orna-

(*Continued on page 92*)

Use it up . . .



That's the thing to do in wartime. Eat every bite of food, save every scrap of soap, make a patriotic habit of stretching all the supplies in the house so they go further, last longer.

Wear it out . . .

This year old coats, old shoes, are a badge of honor. They show you're sensible enough to know that one way to help win the war, to keep prices down, is to wear your old things out!

Make it do . . .

Before you spend a penny in wartime, ask yourself, "Do I really need this? Or do I have something now that will do?" As you patch and darn and turn, you're keeping prices down.

or do without!

When you put your money in War Bonds, savings, taxes, insurance—you're putting your money to work fighting the war and building a sound, stable nation for the peace to come.

It's your money you're saving when you help keep prices down. For it's buying too much when there's too little to buy that sends prices up. And when prices go up—and keep going up—your savings, your future, are in danger.

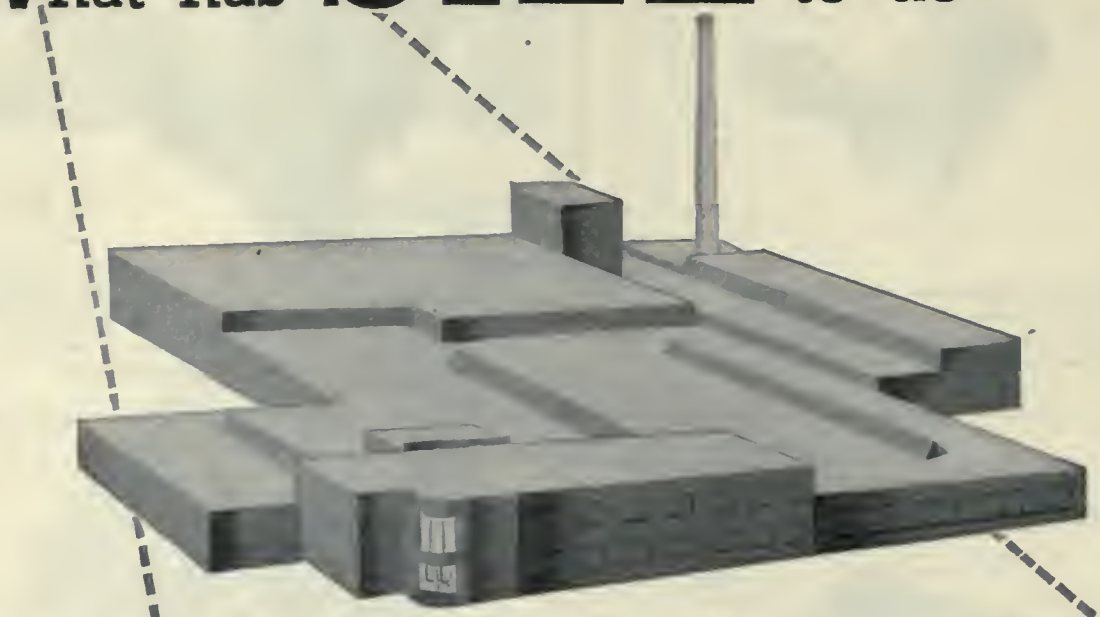
How can you help keep prices down?

By never spending a thin dime you could turn into a War Stamp. By thinking twice—and thinking "No"—at every urge to open your purse.

By wearing old things out, making makeshifts do. Remember, it's the things you *don't* buy that keep prices down!

See that prices go no higher . . . Be a saver—not a Buyer!

What has SIZE to do



with our ability to handle your Postwar Molded Plastics job?

Note: Even though our production facilities are at present devoted to the war effort, an important and time-consuming part of your postwar job can be done NOW. We can help you get your ideas on paper . . . engineering and designing done . . . so you're ready for mold-making. A CMPC Development Engineer, working with your designers and engineers, can do much to insure practical, economical moldability of your plastic part. Get the jump on competition. Ask for a CMPC Development Engineer today. There's no cost or obligation.

Plenty!

For, when the proper time comes, you'll find, in this modern 2½ acre plant, everything needed to produce your postwar, plastic molding job just as it should be produced . . . to insure complete satisfaction, maximum economy, and on-time delivery.

For example . . . you'll find here exactly the type and size of press your job demands. If it can best be produced by transfer molding . . . that's the way we'll handle it. But if injection or compression molding would be better . . . we'll do it that way for you.

If your job requires a 500 ton press for most economical production . . . it's here . . . several of them. If a larger or a smaller one would be more advantageous . . . there's a complete range of sizes, including just the right one.

And whether yours is a simple flash mold or one calling for split cavities and special fixtures . . . we're equipped to design and build it carefully, painstakingly, in one of the finest toolrooms in the industry.

That's the way it is at CMPC . . . through the complete cycle of designing, mold-making, molding, and finishing . . . whatever is needed to give you the best in plastic molding . . . you'll find it here. And back of it all lies twenty-five years of experience plus a nation-wide reputation for quality . . . for doing even the toughest jobs well.

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This special section in PLASTICS is a forum to discuss information for the mutual advantage of the entire plastics industry

what's new in Plastics?

The oft repeated question, "What's new?" must be asked again and again in the plastics industry because yesterday's answer would not be complete today and today's answer would fall far short of tomorrow's new developments.

No manufacturing executive can afford to relax for a moment in his efforts to keep up with the new methods and equipment developed every month for the full exploitation of plastics' possibilities.

To present to each executive a concise and complete survey of all that is new in this expanding field, PLASTICS will compile all of the news possible on materials, methods, equipment and literature. Each month's compilation will have something of intense interest to everyone in the plastics industry as every phase of development will be covered.

Recent progress in plastics has been catalogued and briefly described on the following pages. It pays to fully investigate each item that interests you. To facilitate your research, a more thorough explanation of any subject can be obtained through this magazine.

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Each condensed notice on the following pages is keyed with a number. To request additional information, you have merely to list the key numbers on the postpaid card below. We will then endeavor to see that you are furnished with as complete data as possible concerning the product or publication.

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The card below, you will note, may be used for three services: To obtain information concerning the latest methods and equipment developed by the plastics industry as soon as they are made available; to obtain complete copies of valuable trade literature—including catalogs, handy manuals and background material; and to learn more about the products advertised in this issue of PLASTICS.

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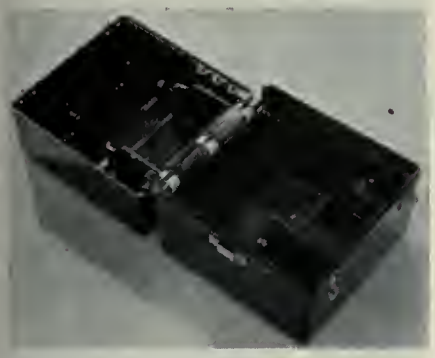
WHAT'S *New* IN PLASTICS

Aircraft Sextant

Bendix Aviation Corporation,
Eclipse-Pioneer Division
Peterborough, New Jersey

An unusually large and intricate molding job was solved to protect an Aircraft Sextant. Upon the accuracy of these vital instruments lives may depend. Such a delicate precision instrument requires extra protection against breakage, shock, weather and many other elements encountered in the flight of a plane. Plastics were chosen to afford the greatest protection and the molding was made of Durez Plastics. Each half of the case is approximately 5 inches deep and 10 inches square. A single extra strip is molded to accommodate the patented double-hinge arrangement. The various divisions are molded into each half. All of the dividers are flat molded pieces molded separately to avoid an undercut. All fastening inserts are molded in. .....(2)



New Plasticizer

Resinous Products & Chemical Company
Philadelphia, Pennsylvania

Possessing high resistance to oils, gasoline and heat, a new resin plasticizer is useful in polyvinyl chloride cable compounds and cable lacquers, wire enamels, vinyl resin fabric coatings, hotmelt compositions and sealing compounds. This synthetic resin, Paraplex G-25, is a saturated polyester, thermoplastic and chemically stable. Compounds in which it is used are essentially non-volatile and exhibit very low flammability, good plasticity, water resistance and excellent stability on exposure to ultraviolet. Because of its unusual resistance to hot oil and good low temperature flexibility it has proven unique as a plasticizer for Buna-N type stocks and is also now going into nitrocellulose lacquers where permanence and non-migration of the plasticizer is important. Although tests have not been completed in this field, its physical properties indicate that eventually it may be used in many types of resistant coatings which must come in contact with foods, such as can linings and hotmelt or lacquer type coatings for frozen food wrappers. Paraplex G-25 is supplied as a soft, tacky, viscous liquid which pours slowly at room temperature. Its specific gravity is 1.06, the acid number is 3.0 (maximum), the color is 15 (maximum), the odor is faint, characteristic, the freezing point 13-15°C, the viscosity (15% in ethylene dichloride) Q-V. ..... (1)

Internal Grinder

Sav-Way Industries, Detroit, Michigan

Specially adapted to plastics tool rooms, the basic characteristics of this new internal grinder are rapid action, flexibility, ease and convenience of operation, particularly for women operators, and facilities for quick, easy loading and unloading. Having unusual speed, this tool is particularly valuable for plastics work as it has a short table stroke—$\frac{5}{32}$" minimum—and extremely rapid table feed and reverse. In addition to electro-hydraulic control, the grinder is available with either manually—graduated in increments of .000125"—and electrically—with cross-slide ratchet feed of .0001"—controlled power cross-feed. The standard machine is available with semi-automatic diamond wheel dresser, adjustable to slowdown of table traverse while dressing the wheel. .....(3)

Solvent-Proof Tubing

Resistoflex Corporation, Belleville, New Jersey

Solvent-proof, rubber-like, and transparent tubing, made of a special type of vinyl resin, is finding a number of new uses in many industries. Because the tubing is tough, strong and completely inert to almost all organic solvents, it is highly useful for low pressure, room temperature handling of hard-to-handle materials. It is not affected by such active solvents as carbon, disulphide, carbon tetrachloride, trichlorethylene, perchlorethylene, acetylene tetrachloride, benzol and toluol or by oils and fuels such as high octane gasolines with the highest aromatic content, which are used in ordnance and aircraft work. Having the lowest permeability to gases of all natural synthetic and rubber-like materials, it may be used on Bunsen burners and other laboratory appliances. The tubing does not absorb the odors of illuminating gases.....(4)

Electronic Heating

Radio Corporation of America
Camden, New Jersey

A new model electronic power generator is a self-contained unit housed in a cabinet 48 inches high, 30 inches wide and 25 inches deep. A built-in and easy-to-reach heating plate assembly is located at the top. This construction enables complete shielding of the assembly. Use of wire mesh in the lid permits viewing the charge and allows gases to escape. A convenient control panel mounts the timer, power controls and indicators.

Power output—
2000 watts—6800 BTU/Hr. (Max.)
Power input .....4.5 Kw. (Approx.)
Line voltage—
220 V. 50-60 cycle Single Phase
Frequency, 27.4 megacycles.....(5)

Packaging Material

Goodyear Tire & Rubber Company,
Akron, Ohio

Utilizing a base of plastic resin, a new packaging material has been developed as an alternative for Pliofilm. To conserve the natural rubber in Pliofilm, made with a rubber hydrochloride base, "V-film" is made with a derivative of polyvinyl chloride. This new film is superior to the rubber product in tear resistance and several other factors, and development work is still progressing, which indicates it will eventually compare in resistance to moisture vapor transmission.....(6)

Attractive Gift Items

Rohm & Haas
Philadelphia, Pennsylvania

Transparent plastic accessories of Plexiglas have been fashioned into gifts that will tempt the sophisticate and please the mathematician with their functional versatility. Among the practical new items are a transparent pack holder for cigarets, a glistening playing card holder which includes space for a pencil, and a paper thin money holder. The new crystal-like photograph frames have proven a most salable item. .....(7)

Aileron Lock Bar

Glenn L. Martin Company
Baltimore, Maryland

A small U-shaped plastic casting weighing only .66 pounds has been designed by engineers of The Glenn L. Martin Company to lock the ailerons and elevators of the PBM-3 Mariner in a neutral position when the big Navy patrol bomber is not in the air. Known as an aileron lock bar yoke, the part is an original plastic design, and is fabricated from BM-7850, Macerated Fabric Base Red Phenolic. Had this same part been designed as a metal casting, it would, in all probability, have been of aluminum weighing approximately 1.30 pounds. The yoke is attached to the lock bar by a chain, and hangs freely when not in use. When in use, a slot in the back of the yoke engages the lower spoke of the control wheel; and the yoke itself fits around the control column and into a locking plate that holds it in position. (8)

Clear Plastic Envelopes

American Plastic Products
Los Angeles, California

A cellulose acetate plastic envelope is designed as a protective covering for work orders, blueprints, maps, etc. It acts as a protection, it keeps all data clearly visible. Bound leather edges on all sides prevent the envelope from tearing or breaking. Patented lockstitch on the binding will not unravel. Flameproof, moisture-proof, air-proof. Standard size, 10" by 12". Other sizes to order.....(9)

Bin Card Holders

Hollywood Athletic Company
Los Angeles, California

Stock room bin card holders made of ivory plastic are available in a variety of shapes and sizes. Stock widths of 5/8", 3/4", 1 1/8" may be had in any of the stock lengths of 3", 4", or 5". Applicable to any flat surface on wood, by means of tacks for which holes are provided or on metal with glue, they consist of a plastic holder itself, an insert tab on which the description of the article may be typed and a covering sheet of transparent plastic. Revised card slips are easily inserted. .....(10)

Nylon Brushes for Seeders

E. I. du Pont de Nemours and Co., Inc.
Wilmington, Delaware

Entering a new field in the food producing industry, nylon-bristled brushes are being installed on mechanical seed spreaders to assure uniform planting.

This brush serves two functions; one to sweep the seed hole clean, and the other to act as an agitator in the lower part of the hopper. .....(11)

Improved Pill Box

Monsanto Chemical Company
Springfield, Massachusetts

Sulfadiazine tablets for soldiers are packed snugly and securely in a specially designed transparent Fibestos plastic box with a separate compartment for each tablet. The cover fits snugly but slides easily so that a wounded man could open it with his teeth if necessary. So carefully designed is the box and so tough is the Fibestos plastic that a heavy soldier may even stamp on it without crushing the box or injuring any of the tablets therein. The boxes are injection molded; cover and base are molded in separate cavities in 32-cavity dies which produce 16 complete boxes in each shot at the

rate of 48 boxes a minute. For further protection, the cellulose acetate of medium high acetal content box is packed in heat-sealed envelopes of kraft paper, cellulose film and laminated metal foil. These are both moisture-proof and air-proof...(12)

Hydraulic Press

Charles E. Francis Company
Rushville, Indiana

A general purpose hydraulic press for plastics, compreg, wood and other production work. Designed for ready adaptability to the individual need, it can be had for any tonnage, hand motor or pneumatic operation. Suited for a multitude of tasks, these presses handle any number of hot plates, steam or electrically heated. In four sizes, 12" square, 18" square, 24" square and 30" square, with or without hot plates. This press is adaptable to most plastic requirements.....(13)

Phenolic Resin Substitute

Makalot Corporation
Boston, Massachusetts

K. E. M. is a thermosetting molding compound requiring only a minimum amount of formaldehyde. The proportion of phenol employed varies from 15% to 16%. This critical saving has helped the acute shortage of phenol and formaldehyde. K. E. M. employs as a base a specific type of wood-distillation residue of no former commercial value. It is not as strong as the usual phenolics, and takes slightly longer to cure at temperatures approaching 350°F. However, it produces very satisfactory finishes and can be supplied readily in black, brown or mottled effects. Suitable for compression molding and jet process operations. .....(14)

Plastic Bubbler Bowls

E. I. du Pont de Nemours & Company, Inc.
Wilmington, Delaware

Clear methyl methacrylate resin has replaced glass in the new sight feed bubbler for indicating the flow of gases in industrial lines. Injection molded, the Lucite provides maximum visibility. The union between the bowl and metal assembly is sealed with a Neoprene gasket. The plastic bubbler, made in both ring and strip types, is advised for pressures of 50 psi and capable of indicating the presence of corrosives or harmful gases. Further advantage is high resistance to ordinary breakage. ..... (15)

Plastic Automobile Tire

Goodyear Tire & Rubber Company
Akron, Ohio

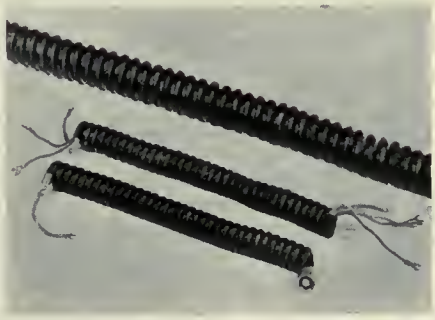
A plastic automobile tire that has already run 8,000 miles raises the possibility that the anticipated post-war competition between natural and synthetic rubber may become a triangular battle royal with plastics in the third corner. The tire, made of Plioflex, is an important advance and a radical departure in the field of plastics in that it is the first elastic plastic capable of being vulcanized during the molding operation. It can be handled in hot molds exactly like natural rubber. Scientific studies of actual road tests show that the carcass and treads of the plastic tire reached maximum temperatures only slightly higher than those reached in tires of natural rubber and much below the temperatures of the tires of the Buna-S type of synthetic rubber. The plastic is not affected by sun rays, which is a great advantage over the highly sensitive natural rubber.

Therefore, the Plioflex can be used for weather stripping without the metal covering necessary to protect natural rubber. The same material can be used in upholstery, furniture, luggage, raincoats, other clothing, wall coverings, draperies, book-binding, insulated wire, jar rings, etc. It has proved so successful for heels and soles of shoes that it will probably be used in shoe uppers made to resemble the finest leather. In that use it will require no polishing, merely wiping with a damp cloth. Vulcanization so improves Plioflex over ordinary elastic plastics that it has twice the tensile strength of the uncured product and at 150°F it still retains the tensile strength equal to that of the uncured product at room temperature. .....(16)

Retractable Electrical Cords

Kellogg Switchboard & Supply Company
Chicago, Illinois

Devoted primarily to the manufacture of rubber-jacketed and retractable electrical cords, Cordage, Incorporated is an outgrowth of research and development conducted by R. D. Collins. He has originated a process which principally involves spirally molded Neoprene and Buna-S. This spiral molding of plastic assures retention of the cord's normal position and the maximum retractability required without the use of wire springs were similarly separated mechanical devices.



Cords so equipped can be stretched to approximately seven times their length and their possible applications by manufacturers of electrical equipment and appliances are unlimited. .....(17)

Rotary Selector Switch

Plastic & Die Products Corporation
Los Angeles, California

The Cam Snap rotary selector switch, manufactured by the Paul Henry Company, is a new type switch for split-second action aircraft control. Operating by as little as a three- or four-degree motion of the cam, this switch is used

for wing flap control, cowl flap control, and other sequence operation. Bakelite impact-resistant phenolic molding material was selected as best satisfying the rigid specifications for this part. The Cam Snap switch must be extremely light —three or four ounces at most—and must be able to pass severe functional tests. These tests include salt spray, contact life, mechanical durability and operations at —65°F. to +165°F.....(18)

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Literature Review

Industrial Plastics

By Herbert R. Simonds

More than an excellent survey of the industrial plastics industry, this book contains all the comprehensive data on how to design with the various plastic materials so that it is a definite "must" for every end-user as well as every chemist and every designer. The lucid style of the author makes this text as interesting as its facts are indisputable.

Mr. Simonds' technical treatise is concerned more than any other available volume with the use of plastics as engineering materials. It is geared to today's industrial progress and told clearly and concisely without erudite chaff. For the user of any sort of industrial or structural materials this is a source of information.

There are so many new types of plastics that even those who have used the first edition of this book as a "bible" will want the second edition. Recent developments to surplant unavailable materials and their innumerable vital uses are authoritatively discussed in the extensively revised edition. Mr. Simonds' research has unearthed all the facts about the wartime advancements in all types of plastics, even including fibers and bristles. Surprisingly enough, he has in some unaccountable way, secured valuable information about Japanese and other foreign research. Material on the chemistry of plastics has been completely revised in the light of the latest discoveries and all tables, statistics and charts have been brought up to date.

The many suggestions for new applications and markets provide fertile food for the post-war planner. Everyone associated with plastics from the man with the test tube right to the man with the sales order book will benefit by owning this text.

385 pages, illustrated—$4.50.....(19)

Facts About Plastics

By The Richardson Company

An informative booklet that answers the questions, "What about plastics?" and "What can plastics do?" It gives fairly the limitations of the synthetics while it surveys the bird's eye view of plastics' possibilities.

For readable, understandable, and authoritative discussions of thermosetting versus thermoplastics and the intricacies of laminations, this booklet is unsurpassed. It suggests proper design of parts for industrial and consumer applications.

Sketches of design possibilities and clear illustrations throughout the booklet are interesting and instructive. Charts of laminate grades and diagrams of molding methods are good pin-up material.

24 illustrated pages. Free upon request.(20)

Industrial Chemistry—4th Edition

By Emil Raymond Riegel

A "refresher" study of all the important processes and practices of the chemical industries, used in producing the materials essential to our war effort. In an authoritative, readable way it covers more than 50 key industries, meeting the needs of the technical and scientific worker, the engineer, the chemist, the teacher, or the student.

861 pages, illustrated—$5.50.....(21)

General Chemistry

By L. E. Young and C. W. Porter

This valuable text has been revised after it has successfully weathered the test of constant use by many students and countless practical chemists. The present revised edition, appearing three years after the first appearance of the book, brings a swift-moving subject up to date. The text is well written for a first course in chemistry in the class room and should interest the well-informed reader who seeks a deeper knowledge of chemistry but lacks the opportunity for class work.

527 pages, illustrated—$5.10.....(22)

CIBANITE

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association activities

Committee Formed to Write Informative Booklets

A new committee of the Plastic Club of the United States was formed to study the needs of the industry and to compile booklets for buyers, store clerks and students. Among the proposed booklets are "What are Plastics," "What to Look for When Buying Plastics," and "How to Merchandise Plastics," etc. Members of the committee are Frank Coyan, Kirby Block Company, Resident Buyer, Carvel Klee, Merchandising and Selling, Clifton J. Cowan, Northern Ind. Chem. Co., Plastic Sales Engineer, Sidney R. Geist, Gemloid Corporation, Vice President, and Sales Manager, Charles E. Gruber, Merchandising and Selling Expert, Kurt Kopstock, Grant Pulley & Hardware Company, Vice President & Sales Manager, Charles Gates, B. Altman & Company, Buyer, Elliot V. Walter, R. H. Macy & Company, Merchandise Manager and Charles A. Peters, Lewis & Conger, Buyer. This committee will collaborate with many plastics companies, schools and other associations to insure the fullest scope, the most expert opinion and the greatest accuracy.

1943 Hyatt Award

The John Wesley Hyatt Medal and $1,000 will be awarded to the individual whose achievement in plastics, no matter when conceived or how long in development, became of wide importance to the plastics industry during 1943. The plastics field is very broad; therefore, it is conceivable that the most important contribution to the industry as a whole for any one year may have been made by a laboratory technician; molder, extruder, laminator, or fabricator; machinery or plant equipment manufacturer; raw material supplier; mold maker or mold designer; industrial or parts designer; a worker in any other field contributing to the plastics industry. Entries for this important award closed on March 15 and a complete survey of all eligible individuals is being made so that the most deserving will be chosen in all fairness.

National Society of Plastic Tooling

A working outline of the National Society of Plastic Tooling was adopted at the organizing meeting in New York City. The purpose of this organization is to make available in published form the "know how" and definite handling technique of industrial plastic materials. The organization will endeavor to bring together those men who are in possession of this knowledge resulting from many months of practical work. The value of research is responsible for the development of many excellent materials available today. However, the actual application of these materials rests with that group of working technicians who have gathered their information by the trial and error method. They are naturally reluctant to broadcast their findings, but it is felt that a group of such individuals, who have all travelled the same road, will welcome the opportunity to discuss their problems and give each other the benefit of individual experiences. Costly mistakes can be avoided and the art of applying plastics to tooling will be greatly advanced by this new national society. Delmar Anderson, Curtiss-Wright Corporation, was unanimously elected President of the Society, Thomas A. Herbert, Consolidated-Vultee Aircraft Corporation as Vice President, Harry W. Tompkins, Curtiss-Wright Corporation as Secretary and Charles H. Miller, Bell Aircraft Corporation as Treasurer.

New Officers of Plastic Club

The Plastic Club of the United States, with a membership of 125, formed to deal primarily with the marketing and merchandising problems of the plastics industry, elected the following officers for this year:

President, Mr. Charles A. Peters; Vice Presidents, Mr. J. Murray Beveridge and Mr. Robert Brinkema; Secretary, Miss Florence English; Treasurer, Mr. A. H. Stemler; Directors: Mr. John M. Cole, Mr. Joseph Schwartz, Mr. C. L. Mathews, Mr. Charles E. Gruber, Mr. Allen L. Perlmutter, Mr. Allan L. Marx, Mr. Frank M. Wallace, Mr. W. A. Priest, Mr. Morris Salinger.

The committees and their chairmen are as follows:

Editorial and Reporting, Mr. Appel, Chairman; Publicity and Public Relations,

— CONVENTION PROGRAM —
Society of the Plastics Industry, Chicago, May 10-12, 1944

Wednesday, May 10

3 p. m. to 6 p. m. Registration

Thursday, May 11

9:00 Registration

10:30 L. H. Amrine, Presiding

10:35 National Anthem

10:40 Address—George K. Scribner

11:00 G. W. Wilcox—"Plastics Section W.P.B."

11:15 Capt. Houghton A.A.F.—"Glass in the Manufacture of Low Pressure Laminates"

12:30 Luncheon—Marine Dining Room
Norman Anderson, Presiding
Presentation of The John Wesley Hyatt Award
Dean Richard F. Bach, Presiding

3:00 William K. Woodruff, Presiding
Dr. J. J. Pyle—General Electric Company "Plastic Developments on the Horizon"

3:30 Movies
"Shaping of Things to Come"—Boonton Molding Co. Presentation
"Formica Movie"—Formica Insulation Company—Presentation

5:00 Technical Committee Meeting—West Room
(Committee Members only)

7:00 BANQUET — Marine Dining Room
George K. Scribner, Presiding
Speaker—W. D. Fuller, President, Curtis Publishing Co.
Past President—National Association of Manufacturers "Road to Post-War Opportunities"

Friday, May 12

10:00 James Johnston, Presiding
Speaker Donald L. Gibb, Dow Chemical Co., "New Method on Handling Material"

10:30 Open

11:00 M. S. Moulton, B. F. Goodrich Co., "Geon Resins"

11:25 "Polyethylene"—Okonite Co., Passaic, N. J. H. B. Slade and H. C. Crafton—Joint Paper

12 to 2 Luncheon—Marine Dining Room
Paul Tietz, Presiding
N. J. Rakas and W. J. McCourtney Technical Report
Speaker—George K. Scribner

2:15 to 4 Division Meetings

1. Molders Division, Allan Fritzsche, Presiding
   a. Styrene—C. L. Jones, Monsanto Chemical Co.
   b. MPR 523 Order—Sidney Ullman, OPA
   c. Mycalex — H. P. Gammill, Mycalex Co.
   d. New National Development—George DeBell
2. Button Division, N. O. Broderson, Presiding
3. Machinery and Tool Division, F. G. Schranz, Presiding
   Speaker—James Neal
4. Extrusion Division—Elmer Szantay, Presiding
   Speaker—James Pierce
5. Fabricators
   Arrangements under consideration

4:15 SPI Business Session (For members only)
Reports of Committees
Membership Committee
Statistical Committee
Committee on Plastics Education
Post-War Planning Committee
Nominating Committee and election of officers for 1944-45

6:00 Reception by Material Manufacturers

7:30 BANQUET
Elmer Mills, Presiding

Mr. J. M. Beveridge, Chairman; Arrangements, Mr. R. M. Brinkema; Finance, Mr. Morris Salinger; Membership, Mr. William Wachtell; Marketing and Selling, Mr. Allan L. Marx; By-Laws, Mr. Surnamer; Research, Mr. W. W. Wall.

Raymond F. Boyer Speaks

The main speaker at a dinner given by the Cleveland Section of the Society of Plastic Engineers was Mr. Raymond F. Boyer of the Dow Chemical Company. His topic was "What Makes Plastic Plastic?" The fundamental difference between the various plastic materials in the thermoplastic group was clearly explained, and Mr. Boyer answered all questions at a round table discussion afterward.

SPE Meets in Cleveland

Before 150 at meeting of the Society of Plastics Engineers in Cleveland, G. A. Fowles, Manager of wire and cable materials of the Chemical Division of the B. F. Goodrich Company, conducted a symposium on the properties and uses of vinyl resins.

After 50 years of continuous use of natural rubber for insulating and jacketing of wire and cable, the plastic industry has in the last five years converted almost completely to synthetic rubbers and thermoplastic synthetic materials, particularly the vinyl resins.

Fowles briefly described the new Geon resins and plastics in the vinyl field which his company has recently introduced, and the "marriage" of plasticized vinyl chloride resins with certain types of synthetic rubber to produce compounds which contained most of the best properties of each. The gap between the plastics and synthetic rubbers has been markedly decreased by this development, he said.

Pointing out that wiring faults are the second largest cause of fires in the United States, Fowles predicted that the extensive use of vinyl resins in postwar house wiring will result in a large decrease in fire department runs.

The special quality of the vinyl resins, which has made their use mandatory on cable for the navy and in many other military applications is their exceptional flameproofness, Fowles declared. This has been recognized by the navy to such an extent that all old rubber insulated wires on service ships has been or is being torn out and replaced with vinyl resin insulation. All new ships are built with vinyl resin insulation and jacketing.

It has been because of the heavy demands for the vinyl resins by the armed services that production facilities for these materials has been expanded six-fold since the war started, and even with this growth · mandatory allocation continues necessary. Use of the materials for civilian purposes has been virtually halted since Pearl Harbor, Fowles said, but a wide and expanding field for the resins in civilian applications is expected when peace comes.

Fowles' associates on the program were C. L. Milton, who discussed compounding of vinyl chloride plastics; C. D. Segner, on the properties and uses of coated fabrics; R. A. Mansfield on manufacturing procedures on coated fabrics; M. S. Moulton on the properties and uses of vinyl resin coated papers; N. A. Fate on the extrusion of vinyl chloride plastics and E. L. Slinghuff on compression and injection molding of the materials.

•

Before the B. F. Goodrich Company program started, the Cleveland Section SPE President, L. S. Shaw of Plastic Industries, requested a report from the various committees. Technical Committee Chairman, Dr. F. M. Whitacre of the Case School of Applied Science named his assistants who will act on the following sub-committees—Materials, Mold Design, Product Design and Production.

Dr. R. C. Allen of the National Rubbery Machinery Company and Chairman of the Program Committee, Akron District, which is part of the SPE Cleveland, along with Warren V. Prince of the Weatherhead Company, Chairman of Cleveland Program Committee, gave outlines of the speakers and subjects of subsequent meetings which are held on the last Friday of each month. Three meetings take place in Cleveland to one in Akron.

Publicity Committee Chairman, Carl F. Linn of the Watertown Manufacturing Co. also reported on his committee's activities. END

Electronic Heating

(*Continued from page 46*)

wasted. On the contrary, in spite of the fact that much voltage appears across the air, the actual power loss is negligible because the loss factor of air is zero.

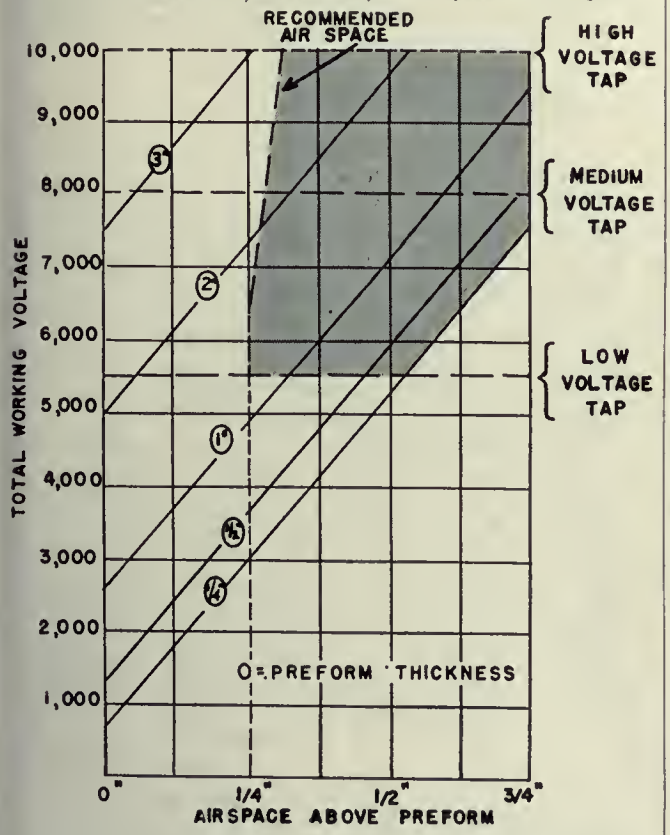
In a practical case the preform may be 1″ thick and the air space ¼″ so that the major portion of the total working voltage will appear across the preform. The division of voltage may be expressed as follows:

$$E_P = \frac{E_T}{(k_a t_p + k_p t_a)}$$

where:

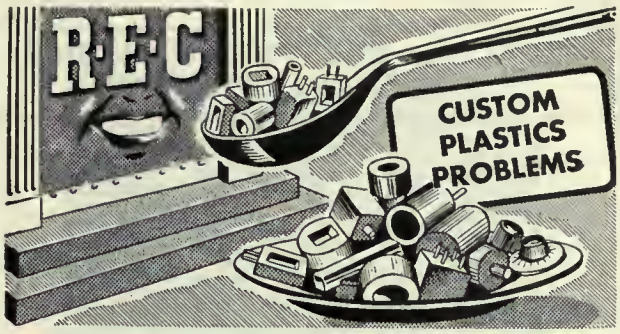
E_P = volts per inch of preform thickness
E_T = volts total across heating plates
t_p = thickness of preform (in.)
k_p = dielectric constant of preform (3.0 — 5.0)
t_a = thickness of air space (in.)
k_a = dielectric constant of air (1.0)

Using the above formula, diagonal lines of fig. 7 are plotted for preforms of thickness ¼″, ½″, 1″, 2″, and 3″. Plotted vertically is the effective working voltage available across the heating plates. The three heavy broken lines at values of 5500 volts, 8000 volts, and 10,000 volts repre-



sent the low, the medium, and the high voltage which may be obtained by means of taps on the electronic preheating unit. Reading horizontally is the air space in inches, which appears between the preform and the upper plate of the heating fixture. There is also on the plot chart a vertical line starting at the ¼″ air space mark, and extending to the top. This line represents the recommended air space to permit normal expansion of the preform during the heating period without danger of wedging against the upper plate and thus making removal from the fixture difficult.

The shaded area bounded by the recommended air space line, the ¼″ thick preform line and the 5500-volt line con-



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stitutes the area of practical usage, if 2 lb loads are to reach 300°F in 60 sec. It will be noted that a broad range of operating conditions will give good results.

For example, in the case of a 1" thick preform it will be observed that whereas it is possible to get the desired heating rate together with a ¼" air space above the preform at voltages as low as 5500, it would also be satisfactory to set the unit for its medium voltage of 8000 which would permit an air space of over ½" above the preform.

Since the dielectric strength of air with volatile vapors in it is hardly over 21,000 volts per inch this sets another limit on the maximum allowable voltage gradient in the preform material. This voltage gradient cannot exceed the dielectric strength of the air divided by the dielectric constant of the preform material. As a representative case we may take 21,000 volts divided by 7 and thus arrive at 3000 volts per in of molding material as near the maximum stress which we may expect to use without breaking down the air space above the preform.

The rate of heat experienced by a molding preform will vary with the applied voltage, the loss factor of the material, and the frequency. The heat developed per pound per second may be expressed mathematically by the formula:

$$H = C \times LF \times f \times V^2$$

H = rate of heat (BTU) per sec per lb of preform
C = a constant involving density, specific heat and unit conversion factors
LF = loss factor expressed as a decimal
f = frequency (in megacycles)
V = volts per inch of preform

It will be observed on examination of the formula that the heat per lb, per unit time, can be increased most rapidly by increasing the applied voltage. By doubling the applied voltage we have increased the rate of heat 4 times. It is also possible to increase the heating rate by increasing frequency and, at the same time allowing the voltage to remain at a fixed value. It has been found as a matter of practical expediency, however, that if the frequency is in the order of 10—20 megacycles all of the common molding materials can be readily handled at voltages safely within their dielectric strength.

The relationship between the voltage stress per inch of preform and the frequency used can be taken directly from the formula for H above. In order to do this, it is necessary to evaluate constant C by assigning known values to H, LF, f, and V. These values come from actual experimental work and in the case of a cellulose filled, vinyl acetate preform having heat applied to it at the rate of 1500 watts per lb and a voltage stress in the order of 2500 volts-in, the value of C is found to be 1015 BTU sec. By substituting this value back in the formula and expressing V as a function of frequency, we find:

$$V = \frac{11.6}{\sqrt{f}}$$

Where:
V = volts-in
f = megacycles

The following table is created by applying the above formula and shows the volts per inch which will be experienced by a common cellulose filled molding material when it is heated from 70°F to 300°F in 60 sec and at the various frequencies listed.

Kilovolts/Inch	Frequencies (in megacycles)
23.2	.5
11.6	1.0
6.2	3.5
4.4	7.0
3.1	14.0
2.2	28.0

The above table shows that unless the frequency is in the order of 14 megacycles, there is considerable danger

of exceeding the dielectric strength of the preform material. In other words, the voltage required for rapid heat treatment at low frequencies would be so high as to cause a breakdown or an arcing-over of the preform at the rate of heating specified heretofore. Lower frequencies may be used, however, if slower heating rates are satisfactory.

Dielectric Loss Factor

The loss factor of the various molding materials varies with the material and the form of the material, such as powder, preform or finished molded part. It does not, however, change with frequency.

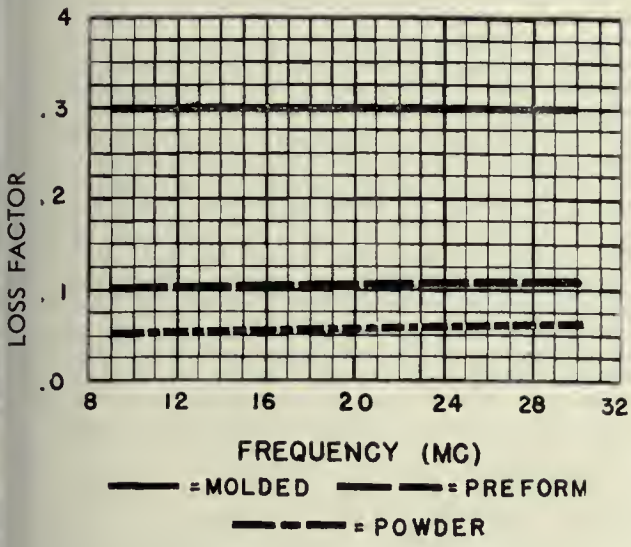

Chart above shows the loss factor as a function of frequency for a cellulose filled molding material such as BM-120 (Bakelite general purpose phenolic) in the forms of powder, preform and molding. It has been observed that from frequencies of 1 megacycle to 30 megacycles, there is no appreciable change in the loss factor.

TABLE I: ELECTRICAL PROPERTIES
COMMON MOLDING MATERIALS
Substantially constant from 1 MC — 30 MC

Material	Dielectric Constant	Power Factor (%)	Loss Factor
Vinyl Acetate			
Cellulose Filled—Molded	6.0	5.0	0.3
Preform	3.7	4.5	0.17
Powder	1.9	2.7	0.05
Phenolic Resin	6.5		
Wood Flour Filler—Molded	6.5	4.5	.29
Preform	3.8	4.1	.16
Powder	1.8	2.9	.05
Melamine Resin			
Fabric Filled—Molded	7.0	4.0	.28
Preform	5.5	2.5	.14
Powder			
Melamine Resin			
Mica Filled—Molded	6.0	4.0	.24
Preform			
Powder	1.7	1.75	.029
Phenolic Resin			
Cotton Filled—Molded	5.0	5.0	.25
Preform	3.7	4.1	.15
Powder	1.8	3.0	.05

Table I gives the electrical properties for a few of the common molding materials. The figures for the cellulose filled vinyl acetate material are taken from laboratory work at Federal Telephone and Radio Corporation, Industrial Electronics Laboratory. The other resins have data taken from what is regarded as reliable sources although they have not actually been checked except in a few instances by the authors. The authors have discussed practical factory heating fixtures in which preforms were heated with electronic energy. END

THE SHAPE OF THINGS TO COME

While the House Of Plastics is today engaged 100% in vital production we are reserving no small part of our time in planning for post-war plastics fabrication. So, whether your needs be only simple store displayers, or elaborate architectural effects, remember that the House Of Plastics has plans for fabrications that will meet your post-war requirements adequately and well. Consultation on post-war industrial design invited.

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Eclipse Fuel Engineering Company
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Capital Report

(Continued from page 80)

ments; house address numbers; jewelry and ornaments; jewelry cases and watch boxes; laminations and covers to photos and pictures; laundry hampers; nameplates; napkin rings; miscellaneous novelties; novelty pencils; plaques and laminated plaques; picture and mirror frames; poker chips; premium items; protective envelopes and laminations for other documents; ration book cases; sculptured pieces; shoe trimmings; sleeve protectors; soda fountain and beverage dispensing accessories, beer scrapers, beverage stirrers, drinking straws; table mats, coasters, ornaments; tableware cases and boxes; vending machines; wall shields.

M-154 was amended March 30 to permit the use of nitrocellulose plastics for the manufacture of decorative buckles and buttons.

M-326-b, effective April 1, placed all acetate molding powder and scrap under allocation. M-326-a now covers only cellulose ester flake from which molding powders are made. Application must be filed on WPB 2945 on the fifteenth of the month preceding the month when the material is required. Bear in mind that all acetate molding jobs now come under either M-326-a or M-326-b, and that the processor must have authorization for all jobs. Plastics Section, Chemicals Bureau, War Production Board, Room 2047, Temporary Building S, Washington, D. C., will send you sample forms and copies of the Order.

The new Order is designed particularly to break up the black market in scrap. WPB found the illegal business was driving prices up to fantastic levels, and was prompting criminal waste.

Interpretation No. 1, Order L-265, March 30, defined radio cabinets, regardless of materials from which they are made, as "electronic equipment," subject to manufacture and restrictions under the Electronic Equipment Order.

M-115, amended March 25, specifically excludes tubes made of plastics, with or without the addition of a steel fastener at the bottom, used for shaving cream, dentifrices, or similar materials, from the regulations that affect metal tubes.

Order L-238, amended March 23, permits manufacturers of plastic temples of sun glasses to obtain wire from any source.

Users of synthetic resin finishes, lacquers and lacquer thinners, must give complete end-use information to their protective coating suppliers when ordering material. Materials containing phenolic resins, urea resins, ethyl cellulose, methyl isobutyl ketone, must be supported by a written end-use certification by the consumer to the manufacturer. Special coating containing phthalic alkyd resins, phthalate plasticizers, ethyl cellulose, in addition to end-use information must also supply contract and specification numbers before allocations are made. End-Use List WPB-217 is suggested by Chemicals Bureau as an adequate guide.

Late March Chemicals Bureau announced supply of casein was more favorable and that it would consider application from manufacturers who had not used the material in the past. Applicants were requested to file Form WPB-2945. Methyl abietate and hydrogenated methyl abietate, used in plastic production, under allocation since October, were freed late in March from the controlling Order M-340. At the same time alkyd resins, which had been relatively easy, were placed under tight control. All phthalic alkyd resin allocations issued before February 15, 1944, were revoked, as covered by Directive 1 of Order M-139. Supply of cuprous oxide and the alkyds is so short there is not enough for Army, Navy, and Maritime Commission. Alkyds are short because phthalic anhydride was requisitioned for additional military uses. Specifications have been changed for use of the resins by Army and Navy.

M-217, issued March 9, defines "plastic soles" as containing more than 25% by weight vinyl polymer as defined in M-10. After April 15, footwear using plastic soles were restricted in size and color.

The WPB Chemicals Bureau announced plans to liquidate the surplus Army inventory of 364,450 lbs. of mercuric chloride.

Animal-base glues for plywood have fallen low in supply, but phenolic and urea resins are more plentiful and have

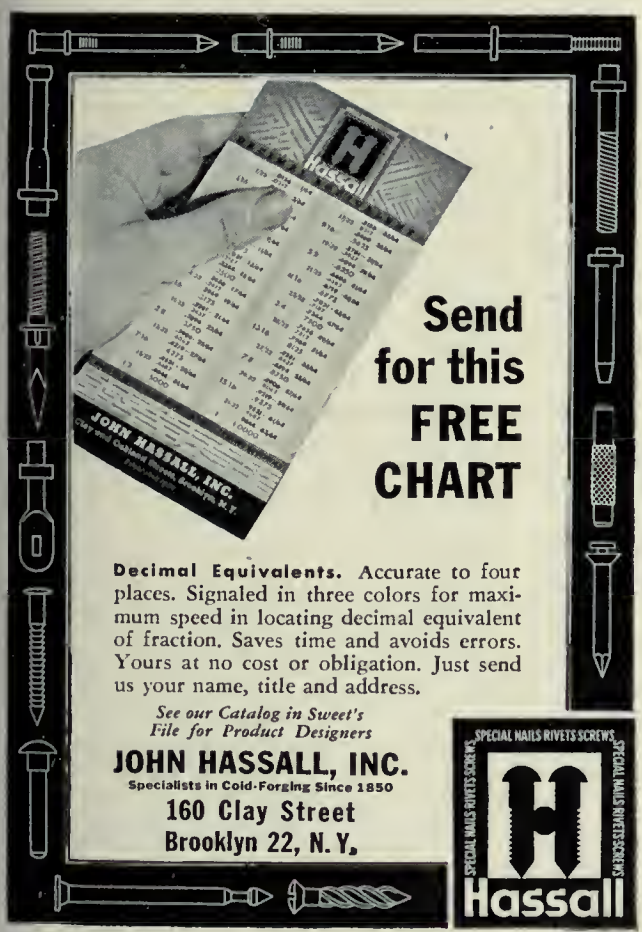
assured production of 42,000,000 ft. per month of hardwood plywood.

WPB announced the need of the military for an insectifuge has made necessary the expansion of the productive facilities of the nation to make 12,000,000 to 15,000,000 pounds phthalic anhydride per year. The expansion of facilities is already under way. It is expected to provide more secondary material for the plastic industry.

There is whispered word of many new materials capable of withstanding more heat, of materials that are lighter or tougher, or more impervious, or more easily worked and more widely useful. But discussion is completely restricted in public by the hush-hush policy which is imposed on 90% of the news of the paramount interest to the processor. After the war, it is certain many amazing facts will come forth that now are known only to a limited number of fabricators, processors and others engaged in some phase of the industry. The armed services have clamped down almost completely on news about techniques and products and ultimate commodities; and the Chemicals Bureau naturally is under an extraordinary strain in keeping the lid down. There is no agency in WPB that is run more completely under concentrated control than the Chemicals Bureau, and there is no part of the Chemicals Bureau more completely cautious than the Plastics Section. Some of the difficulties are attributed to the fact that the whole industry has expanded so swiftly the past three years that even the men in WPB have genuine trouble in keeping apace with the swiftly changing picture of new materials, new products, new problems, and the need for adaptation to the many new aspects. The men in the Plastics Section are mostly young men, and many new men, some are relatively new to the industry, as well as not fully acclimated to all aspects of the industry with such bewilderingly rapid changes. The extraordinary caution which inhibits many normal actions therefore is easily understood and warrants sympathy.

W. F. Twombly, one time a du Pont official, has been appointed assistant director, Chemicals Bureau, in charge of the Plastics Section.

END



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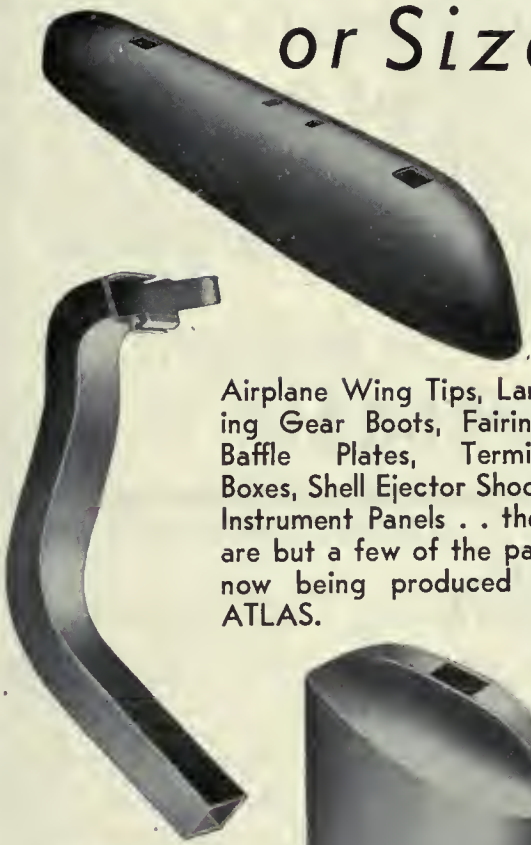

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Phenolic Instruments

(*Continued from page* 40)

housing and turntable were aluminum castings; the corner posts were of plate aluminum; and the sides and top were of sheet zinc. The redesign, using plastics, was intended to reduce the effect of atmospheric changes, simplify assembling or dismantling, maintain a low breakage frequency and reduce costs. The major problems were the housing mold design, surface tolerance on the turntable, and marking the turntable.

The housing design called for two molds, one for the base plate only and one for the two halves, which are identical only in over-all dimensions. Inserts and guide holes differ in the top and bottom halves. By a series of plugs and insert guides, it was possible to mold a quantity of one section, then make a temporary mold change and mold a quantity of the other section. Since these sections measure about 13 by 10 by 8 inches, a saving in mold cost was effected.

The molding compound required for these housings had to have exceptional dimensional stability in order to provide a very rigid set-up, a good flow and a good finish. A Durez black phenolic material was chosen which, besides meeting these requirements, also proved able to take close tolerance work both for assembly of the housing and for alignment of interior mechanism. Close tolerances are also needed for the top of the turntable to insure a level surface and perfectly centered insert.

By intensive design and production study, a method of accurately marking the turntable by the mold-in method was devised, based on the minute shrinkage property of the Durez compound, which resulted in a negligible number of rejects. The molded markings are given a white enamel wipe-in and their preciseness determines the accuracy of the tester. Actual use in the field throughout the world has proved their accuracy to be within ½" in 1080', equal to three full turns of the table.

No machining of castings is required for this type of tester. Since the use of plastics eliminates the metal side plates, it also eliminated drilling and assembly operations. A 35% saving in weight was achieved through the use of plastic instead of metal for the housing. Despite increased labor costs in comparison with those at the time of construction of the metal units, the bid of the manufacturer, McCaskey Register Co., was approximately 15% lower than was the cost of the earlier models. END

Smithsonian Displays Plastics

Recognizing the ever-increasing importance of plastics and resins in industrial production, the Smithsonian Institution, Washington, D. C., has just installed a plastics and resins exhibit prepared by Plaskon Division, Libbey-Owens-Ford Glass Company, Toledo, Ohio.

Purpose of the exhibit is to give visitors to the Smithsonian a quick, but amazingly complete, picture of how urea-formaldehyde plastics and resin glues are compounded and used in the manufacture of a wide variety of products.

In the plastics section, the process of molding urea plastics is illustrated by six photos, below which the Ostwald Chromatic Circle is reproduced in molded color discs. Actual products made of Plaskon molding compounds are displayed including closures, buttons, surgical windows, refrigerator hardware, fluorescent fixtures, stove panels, kitchen hardware and a large housing for a weighing scale.

In a horizontal center panel the chemical steps followed in producing urea-formaldehyde plastics and glue are interestingly portrayed. At the base of the exhibit is an actual structural section of an aircraft wing made with a resin-bonded plywood and assembled with resin glue. END

Low Pressure Molding

(*Continued from page 74*)

of material processed. These savings increase as larger pieces are molded.

In order to understand the Duramold process, it is necessary to examine the various basic materials which can be processed. A combination of materials is needed: Fibrous, strength-giving or reinforcing material and bonding and preserving materials. In addition to the wide variety of veneers of different strengths and densities, which can be used in an unlimited number of combinations, there also are all sorts of other fibrous or reinforcing materials.

Among the natural fibers there are wood fibers, sisal fibers, cotton and linen fibers. Also, there are such materials as glass fibers and fine steel wire or wood. These fibers can be combined in their original condition with the bonding material or first processed into such forms as paper, cloth, glass cloth, wire screens, etc. Besides a great number of different types of resins, bonding materials also include rubber compounds.

Duramold is a process for producing new kinds of structural laminates employing reinforcing fibers combined with a binder to give a variety of composite materials. These offer new long enduring, structural properties and the latitude being fabricated in large, complicated shapes. Each combination requires a specific manufacturing technique with proper process controls at each step if a consistent product is to be obtained. END

Precision Extrusions

(*Continued from page 39*)

the plastic construction has to be able to stand up under the hurried and frequent handling by people concerned more with the earnestness of the task than with the physique of the records.

The Casualty Branch, besides other departments of the government, the Army, the Navy and numerous essential industries rely on this visible record system developed by the Visible Index Corporation. Known as Visirecord, its simple technique makes it the "world's fastest visible record-keeping system". To achieve its function Visirecord incorporates miles of extruded cellulose-acetate-butyrate, every inch of which has been held to precise thicknesses.

Substitute Becomes Superior

When aluminum joined the long list of critical materials, the company searched for a material which could be held to ±.005" in precision manufacture in order to meet their exacting demands.

In plastics they found not only the dimensional constancy they required but the advantages of color, transparency, ease of manufacture, smoothness and noiselessness that have both facilitated production and improved the use. With the switch to suitable types of plastics—extruded strips in transparencies and opaques in the complete chromatic scale—improvements were noted in the methods of segregating records, making them easier to find and file. Manufacturing time was reduced, the appearance enhanced, noise of shuffling minimized and maintenance cost lowered.

Plastics have proven so superior for the indexing system that in one installation alone over forty-five miles of extruded strips were used for end rails, transparent face

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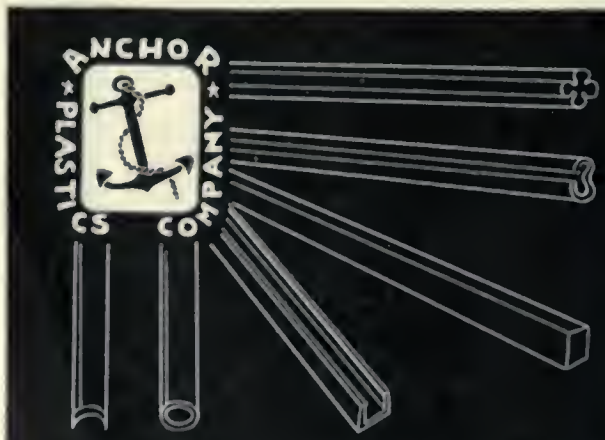

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strips, top and bottom wearproof edges, index tabs and signals, intermediate dividers and color identification.

One of the most important features of the filing system is the pertinent data on a horizontal margin which is always visible through the top transparent facing strip. This information, i.e. name, serial number, wounded in action, killed, taken prisoner . . . or in equally busy post-war installations, credit ratings, frozen accounts, parts lagging in production, or hundreds of other vital facts must be read distinctly through the facing protecting the upper edge.

Transparency and Sturdiness

Heretofore various strips were tested for this important job and in .020" thickness. This is the maximum space allowed for in the metal pocket holding the strip. Facing

Transparent dumbbell shaped extrusion which is split in half and cut into lengths to make tabs with beaded edges

strips, cut from sheets 51" by 20', then had to be polished to a bevel at the top to prevent the file clerk from cutting her fingers.

Due to consistent heavy operations, breakage occurred on particularly active files and a new solution had to be engineered.

Balance Removes Stress

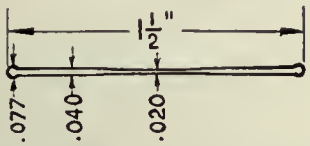
Extruded Plastics, Incorporated, Norwalk, Connecticut, had held fine tolerances in the manufacture of the twenty-three different gages of divider and rails. They were put to work solving the problem of making an unusual cross section in a suitable transparent reinforced plastic that had to be completely free of stress.

First, an extrusion of ¾" was tried with a bead on one edge. The finished extrusion curled and distorted, showing permanent stress. The need for a balanced extrusion was decided upon to eliminate the stress.

After a long series of careful experiments, it was found that best results were obtained from Tenite II (butyrate)

extruded as a strip of 1½" width of a "dumbbell" cross section construction. When slit in half, the extrusion provides endless yardage of the desired ¾" wide transparent facing strip with a smooth beaded edge for strength and comfort. The Tenite II supplied the necessary clarity and its toughness and stability were already proven in the end rail extrusions.

A cross section view of the extrusion resembles a dumbbell having a ball head forming the bead of .077" at each edge, then a flat section of .040" directly below the ball for 7/16" tapering sharply to .020" in the center for ½" then back to .040" for 7/16" and finally the ball of .077" at the other end.



This section, when split in half lengthwise provides the ideal visible strip, with ball top providing a smooth beveled surface agreeable to the operator's hands and sturdy construction eliminating breakage.

This reinforced section has met the most rigid tests both in manipulation and atmospheric and temperature conditions, and maintains exact straightness of shape in the tops of the dividers which measure just over 25". At either end of the divider they fit into the slot of the butyrate end rails and a stitch is countersunk securely into the end rail.

The stitch is countersunk through sections of butyrate ranging from .040" in thickness to .130" with a specially designed bead in the automatic stitchers.

Transparent plastics index tabs have been designed to snap over the bead and lay flat against both sides of the strip at its .040" depth. Here again the new dumbbell construction has eliminated spring steel and manufacturing time, as the former .020" strip being perfectly flat, required a transparent plastics tab with a spring clip arrangement affixed to both ends of the tab to insure proper fit.

Visirecord forms, cards or ledger sheets are punched at the bottom with notches spaced ⅜", .05", .06" or any multiple thereof, depending upon the requirements of the record. These notches assure accuracy of alignment and ride over correspondingly spaced rods resting on corduroy, in which the card forms stand in horizontal echelon up to 43 cards per bank, depending on width of form and desired visibility.

Each of these card banks are separated by means of a divider made of specially constructed hard Masonite with a metal pocket on the top which contains the ¾" transparent butyrate face strip, ¼" being held in the metal pocket and ½" providing visibility at a glance. However, the walls of these dividers must be separated from each other at certain precise distances ranging from .140" to .580" providing spaces to contain the echelon of cards. As the dividers may be leaned backward or pulled forward at a fixed 20° angle (the card banks following this movement) and unless the echeloned card bank rides freely between the dividers, cards are liable to move upward and out of alignment. To combat this condition, the dividers are provided with extruded end rails in sizes starting at .140" and graduating .020" up to .580". In some applications one or more cardboard intermediate dividers may be used between one or more banks of echeloned cards, between the primary Masonite dividers. These conditions are dependent on card width, card stock thickness, desired visibility and component build-up in echelon overlap.

END

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One-Coat Protective Dipping

(*Continued from page* 50)

some work has been done on coating the porcelain surfaces of spark plugs.

Parts which are of plain construction are most suitable for this type of coating. A minimum of shut in air, the principal source of corrosion danger, is the objective. In this connection, the coating will bridge a hole up to ⅛ inch in diameter, or an opening up to ½" such as on spark plugs.

Economy and Speed

General Motors has been using the new wrapping method for about a year, now specified hy the Army for all automotive parts packaging. The material is designated by specifications A-X-S-1167 and is known officially as stripping ethyl cellulose protective compound.

General Motors' experience with packaging has disclosed the fact that it eliminates the need for coating a part with a corrosion preventive before wrapping, because the dip wrap contains 40% to 50% mineral oil and wax. Hence, since there is no corrosion preventive used on the part, the part does not have to be stripped down when it is to be used, and so it can be unwrapped and immediately placed in service in the field. It does not adhere to steel and it meets a rigid test for ready stripping.

Among its other advantages, many of them of importance in peacetime uses are:

1—It reduced manhours of packaging time from 60% to 90% depending on whether the conveyor system is used. As an example, in one plant using the method, one employee is performing the wrapping formerly done by forty. The over-all time for treating a piece or group of pieces is from 10 to 15 seconds, including the time required for drying.

2—It frees for other war uses such critical materials required in the old hand-wrapped method as corrosion preventive, wax impregnated paper or cord and microcrystalline wax for the over-dip to give a hermetic seal.

3—It withstands cycle tests of alternate heat, cold and straight water immersion and straight humidity tests for 3000 hours as compared to 1000 to 1500 hours with the old method.

4—It provides complete protection of a temperature range of from —40° to +300°F compared to —10° to +140°F with the former method.

5—It permits parts to be packed at the plant with the grease that will be used in service since it traps the grease in the pack where it is ready for instant use when the part is stripped for assembly.

Broad Merchandising Possibilities

An interesting experimental "carton" pack of several like parts, such as bolts, has been made. This allows about a dozen to be packed in a slab-like carton which facilitates handling; each one may be broken off separately, or cut off, keeping the remainder of the pack intact and fully protected.

Important wartime uses now being considered are in the protection of machine tools and surgical instruments. The transparent types of coatings allow the important indications on the tools and instruments to be read easily without removing the coating. At the same time, the coating gives the essential protection during transit and storage. In the case of surgical instruments sent to tropical, or arctic, locations,—the significance of the wide temperature range which the plastic withstands is obvious.

Transparency has not been a part of specifications for Ordnance requirements up to now. Although part numbers

or instructions may be clearly read through, this is not important because separate Ordnance numbers are given to each part, differing from the stamped manufacturers' part number, and external labeling or tagging for identification is required. The present translucent formula is therefore satisfactory for this use. The U. S. Army Air Forces, however, have been interested in the use of a similar coating which is transparent.

A suitable formula for transparency has not yet been worked out that will meet the existing tests. The major difficulty has been the test of 48 hours at 375°, but it is believed this test need not be met for ordinary uses, certainly not in normal post-war operation. The principal reason for the test is to approximate the conditions that would result if heat were left on under a pot over a weekend when the coating plant was shut down. However, as the best practice calls for replacing the coating gel every three to four hours, this should not occur in actual practice.

With the chance for some leeway on specifications in peacetime, and the availability of critical materials now restricted so that they cannot be used for this transparent coating, those concerned with the development are confident that transparent coatings meeting every desirable test will speedily be available.

This will mean much in post-war merchandising of many products. By the addition of a dye, the transparent coating may be made in green, yellow, red, or other shades to enhance eye-appeal and increase sales.

Already, some experimental work has been done on such objects as chisels and hardware for a large department store chain, pointing clearly toward an important postwar field for this coating. Salvage of the removed plastic coating offers an interesting possibility of economy in inter-plant shipments. END

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Shatter-Resistant Gages

(*Continued from page* 34)

My company has become one of the most important sources for these strategic instruments. We have constituted research into the uses and handling of plastics, thereby developing and broadening the whole field of fabricated acetates and acrylics as applied to the manufacture of pressure gages.

Under Many Conditions

These instruments are used in a great variety of applications around air fields and in airplane engine factories where pressures or air flow must be measured with finer accuracy than can be obtained with spring gages. They are in constant use for checking air pressure and air flow in air-conditioning and ventilating systems, gas fuel lines, dust collecting systems, and pressure in wind boxes of stoker fired furnaces, draft over fire and up the stack in all heating and power plants. They are used extensively in laboratories and in a great variety of manufacturing establishments.

Most of the Dwyer manometers are made of extruded Tenite II (cellulose-acetate-butyrate) tubing curved into a U-shape with each end bonded into a Lucite acrylic block drilled hollow as a reservoir to trap overflow of reading fluid in case of excess pressure or careless handling. The extruded butyrate's dimensional stability and response to pressure made it particularly suitable for the tube gage. Another type of manometer is cut from a solid block of Lucite. The path of the reading fluid is drilled into the easily machined acrylic and then reamed to micromatic smoothness. Large diameter wells are then drilled in the same manner for the safety traps.

Types of Fabrication

The traps, in both the solid acrylic instruments and on the tubing models, are the same. A well is drilled into an acrylic block. It is threaded at the top for the stopper and a small diameter hole at the bottom leads to the tubing of the gage. Disproving the old saw, a small square block fits into the round well and sits atop the lower opening. Being of acrylic, this block is easily fashioned so that it is concave on the bottom to allow atmospheric pressure into the tube and convex on the top so that a valve made of curved neoprene rests lightly on the block. A steel pin—the only metal in the entire gage in some models—rides in a hole drilled through the cube and seats the valve.

The stoppers are of gleaming red acrylic. They screw easily into the wells of the same material and have tapered openings to admit the pressure to be measured. If the fluid in the gage is forcefully blown or tipped against these openings the neoprene valve bars the way and the liquid is trapped in the well.

On some models of manometers a little float was needed in the trap. These were made of wood. The dye in the oil that was used for reading soaked into the wood and caused discoloration. Now the floats are of acrylic bonded to a pin made of thin butyrate tubing.

The instrument can be connected to any assembly with tapered tubes of butyrate. Light pressure will squeeze the tube with about a 3° taper on its outside diameter into the stopper that has a corresponding taper. A number of these convenient connections were tested to 75 lb. pressure without any evidence of a leak and it is certain that even greater pressures can be safely transmitted through the coupling. Formerly—for twenty years—metal connections were used and must still be used with glass tubing. These metal fittings necessitate screw

fastening and unfastening with its time loss and danger of thread injury. The simplicity with which the plastics parts can be joined makes it possible to vent the gage to atmosphere for zero setting and also provides for the occasional addition of fluid much more easily than where three-way petcocks are used. Furthermore, the plastics connections are much less liable to leak.

Where a screw connection is needed, a small piece of black Saran vinylidene chloride is wedged into the red Lucite stopper and the assembly is screwed onto the threaded Saran coupling. Where static tips are required, two five foot lengths of butyrate tubing connect the stoppers with the tips which are made of solid butyrate rod stock turned down on a lathe to a fine point.

Advantages Gained

Altogether the flexible plastic tubing assemblies are perhaps the most indestructible pressure measuring instruments on the market. Their light weight and safety features make them especially suitable for portable use by test engineers in places where shatterable gages would be dangerous.

These assemblies may be mounted on plastics backs with the tubes nested in grooves. So far wood has been used because the individual jobs have not been classified into the quantities necessary to make special molds. Also, the calibrations may be mold imprinted on the plastics which would lend themselves to the purpose. Now the scales are individually printed on wood after direct calibration to compensate for any possible variation in diameter of the tubing.

The scales graduated for the use with oil, water or mercury fluids can be adjusted and set with a screw clamp. The effects of elongation of the tube or evaporation of the fluid can be compensated by sliding the scale to a zero setting.

On some inclined gages a novel use of plastics provides for adjusting the oil column to zero. The reading tube is extended through a U-bend to a deep well which is raised and lowered by a micrometer screw. This screw adjustment permits the addition of a large amount of oil at a time, and moving the well itself gives very sensitive and quick zero setting without scale sliding.

The superiority of the plastics materials is evident in the manufacturing processes. The tubes are bent to any necessary shapes by a process I developed which preserves the inside diameter without any measurable distortion.

The ease with which acrylics can be drilled is well known. There is further simplicity of fabrication in the bonding of butyrate to the acrylic with the brushing on of a solvent which welds the two materials into an integrated assembly—100% leakproof and close to that percentage breakproof.

Conclusions

In economy of manufacture, in practical use, in safety of operation, in freedom from damage and in performance, pressure gages made of plastics have proven undeniably superior to those made of brittle shatterable substances.

The success of the plastic tubing in this important use presages its incorporation into many instruments where glass was formerly employed. In this application fluids of one sort or another are carried by the plastic tubing. In post-war applications gas may be confined in a plastic developed for the purpise. Neon tubes of such a material would have many of the advantages I have found in its favor for use in pressure gages.

There is no doubt that as we become more efficient in the manufacture of the new materials that are now being developed by the chemists, we may make more and more of our instruments completely of new synthetics. END

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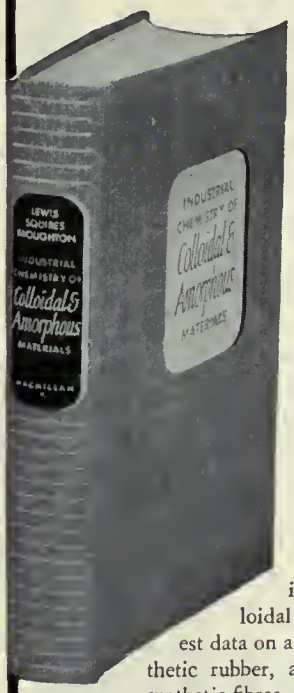

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DESPATCH OVEN COMPANY MINNEAPOLIS

Designer Looks at Plastics

(Continued from page 31)

for this use. The plastic we used gave us everything we wanted in color, quality and selection of colors. Four shades were chosen for the color range—brilliant red, yellow and green and black with white. But this material could not have been decided upon without its additional property of acid resistance and the fact that it would not dissolve or bleed.

With the Ducky Blanket Clips, too, we wanted color, soft baby colors this time, and it was necessary to avoid all sharp edges to prevent the clips from tearing delicate baby blankets. The retail price possibility was limited. With the plastic we met the requirements of attractiveness and practicality and were able to effect the economical production of a rather complicated shape without involved finishing processes. Cellulose acetate was selected for the molding material.

Often our problems are the redesign of equipment and plastics have solved them for us from the standpoint of appearance, easier operation and simpler manufacture. Almost everyone remembers the old fashioned green glass dental spotlight which in use was always too hot to handle, broke readily and had many parts of various materials. Besides wanting in appearance and efficiency it was costly to make and to assemble.

First Redesign

Our first redesign of this lamp for Burton Manufacturing Company included ventilation slots molded into the phenol-formaldehyde housing to overheating and breakage. The lamp then looked and operated in step with dental progress. We later took further steps with the redesign of the lamp in diffusion and focus so that the patient could look into the light comfortably. We combined this light on one stand with two other lamps needed in the dental office with the further and more efficient use of plastics in all three and for parts of the stand.

The biggest hazard to the future of plastic products is the fact that everybody is interested in plastics and very few people know enough about their properties. It's time more people learn about them, or consult those who know. The total production of synthetic resins rose from about 50,000,000 lbs in 1933 to a figure between 750,000,000 and 800,000,000 lbs last year, with an increase by 50% in just two years, between 1940 and 1942. Material in quantity like this and the equipment it requires in manufacturing and fabricating must be used after victory. It must be used for the best purpose of peace, to keep factories humming, to keep names on payrolls and for the products an eager public expects on the first possible day after the shooting stops.

Plastics Must Be Applied with Knowledge

It is not only the use of plastics which must be furthered but the correct uses of the right materials. Plastics are not new but the public realization of them is, even the manufacturer's recognition in general is recent. New plastic users, or old users of plastics who want them for new purposes must start with the premise that the successful use of plastics for any purpose is arrived at through the study of each individual plastic and its use for the particular problem. There are many kinds of plastics and the one to use must be indicated by an expert who knows their properties, their application and your problem.

Plastics have failed on many jobs, but it was often for reasons other than that they should not have been used. Sometimes the walls of the product were too thin, corners were cut too close in manufacture, sometimes designs were

wrong for them; any other material would have failed under the same conditions. In very many instances today plastics are ordered by experimenters, those who know very little about plastics and simply try out one and another until one will just make the requirements of the job. It isn't the best plastic geared for the greatest efficiency and smoothest, most economical operation in the given condition. It is just the first one that would do.

The plastic engineer who follows the rapid development of plastics every day should be depended upon to recommend the right plastic for the job. He has new ones to suggest right now through the recent advancement of nylon into the realm of greater powers of heat resistance, of ethyl cellulose to withstand lower temperatures, of saran for new acid resistance—and these and others for perhaps a dozen more reasons.

Molding technique presupposes a mold designed for the particular problems of plastics and for the greatest manufacturing efficiency. New machines are being designed today to increase the possible size of the product. Electronic heating developments promise four improvements: 1 the increased size of the form to be molded, 2 the possibilities of molding thick and thin sections, 3 molding in intricate inserts, 4 reductions in cost and operating time. New low and no-pressure molding reduces mold costs, permits the molding of large strong pieces and again reduces manufacturing costs. The prices on all plastic materials are constantly being lowered and wartime stepped-up plant facilities and chemical production will permit even further reduction. The recommendation of a plastic material should be made from the background of a wide knowledge of the picture as a whole.

Plastics stand on their own feet in consumer appeal alone. In a recent survey we asked houseware buyers what they believed their retail customers' opinions of plastics to be, and these buyers without exception told us that their customers are eager for plastic products, that they did not consider plastics a substitute nor had any disappointment in early plastic housewares diminished the demand for more.

The demand for new products will reach an all-time high by the day of victory. This time manufacturers are working alone, without the constant spur of seeing competitors' advance in new products. Competition is silent, invisible but active, and the manufacturer who plans ahead to produce the new products long awaited by the public will earn his share of its favor and pocketbook. He will have a position of leadership he may be able to hold for years while those who did not work well alone are catching up.

Plastics have advanced more in the few war years than would have been possible in decades of peace. They are ready to serve as a powerful factor in the postwar conversion of industry. END

Post-War World in Transparent Packages

Much of the post-war world is going to be delivered in transparent packages, engineered for protection as well as eye-appeal, if exhibits at the annual Packaging Exposition in Chicago can be taken as accurate forecasts.

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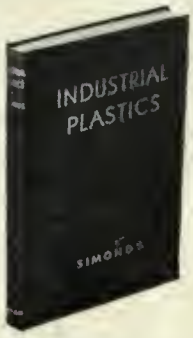

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Wartime Developments
(Continued from page 21)

thing that floats, rolls, or talks with our Armed Forces. Extruded wire covering includes almost all of the thermoplastics, vinyls and butyrate having an edge perhaps. Extruded pipe has replaced copper in aircraft. It has found its way into plumbing fixtures with certain advantages. Extruded shapes will be commonplace after the war. Because it is made in continuous lengths, it will have definite advantages in fabricating many things.

If nothing else, plastics are versatile and can be tailored to meet prescribed conditions. Nylon, for example, is not new. But it jumped from hosiery to parachutes, then to rope, and as if that were not enough, chemists have converted the nylon formula to a molding compound to bring its physical properties into entirely new fields. Strangely enough, this heat-softening plastic will resist temperatures nearly as high as most heat-hardening plastics (higher than some) and may be injection molded in conventional equipment with slight alterations. Nylon buttons and zippers can go to the dry cleaners without a shiver. They can brush up against the presser's iron without distortion, hence need not be removed.

Rope Made of Nylon

Rope, made of these fibers, is not new. It was used some years ago to pick up airmail sacks from non-stop stations although not many knew about it at the time. When Army gliders were towed by speedy planes, nylon became the tow-rope because of its peculiar ability to stretch rapidly and contract slowly, acting as a shock

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absorber as well. It has the strength of steel cable without its weight and will outwear manila in any test. Because it is light and easy to carry when wet, Armed Forces mountain troops use it as climbing rope but there'll come a day when it will become clothesline that doesn't sag; towlines for crippled automobiles; anchor rope and halyards for boats.

Nylon is but one synthetic fiber. There are many. Single or multiple strands will become sutures which offer no quarter for microbes or germs; fishing lines that land the big ones; shoe laces that last longer than shoes; brush bristles for teeth or paint.

Fictitious Promises Cloud Plastics' Future

One might be led to wonder if the crystal-gazer of tomorrow won't use a methacrylate ball instead of beryl, and choose such words as *hexamethylenetetramine* and *polydichlorostyrene* in place of the traditional *abracadabra* for his mystic rites. Even so, his mystical probing into the plastics future may be clouded by fictitious promise of things that ought to be but will not materialize. This may be a good time to throw out the whole mystical procedure of plastics prediction and begin to look into more prosaic and practical things such as properties charts, engineering data, and cold facts.

A good many of these data and facts have resulted from producing implements of war. They have been carefully detailed and set down to guide those who want to get the most out of their plastics planning and avoid past vacuous attempts to make plastics do jobs they are utterly unsuited to perform. If these data and facts are woven into a fabric with a warp of engineering and a woof of imagination, a good many practical plastics products should result. END

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Metal Plated Plastics

(Continued from page 52)

Water absorption in any plastic is reduced or becomes nil according to the thickness of the coating applied.

The strength of plastics is improved by a metallic coating. This varies according to design, thickness of metal and kind of metal deposit. The tensile strength of the metal plated plastic may be increased from 10% to 30%. For example, cellulose acetate in a standard test with tensile strength of 6,500 psi was increased to 7,500 psi when metal plated.

The above can be applied to the resistance of the absorption of oils and solvents. In the case of the plastic coming in contact with oils, solvents or other corrosive substances the plating of the surface results in consequent elimination of surface absorption.

For aircraft items vibrational resistance is of prime importance. It is necessary that the electroplated plastic parts withstand the vibration of the airplane at the highest flight speed. For example, an aircraft part designed of compreg-wood measuring several feet in length, plated

Army, Navy and Marine honorable discharge button. Left—24K gold electroplate. Right—plastic molded base.

with copper, can withstand five hours of simple harmonic motion varied between 10 and 55 cycles per sec. with a maximum excursion of 0.6". The plating specifications can be varied to meet the design of the article over a wide range of vibration requirements.

Rapid temperature variations are given prime consideration in the manufacture of aircraft parts. Under flight conditions temperatures may change from + 150°F, 100% relative humidity to —60°F relative humidity nil in a very short space of time. Aircraft parts which have been tested under laboratory conditions withstand 30 complete cycles at the above conditions. On testing certain designs there has been no breakdown for 60 cycles and more. Tests of this type have been conducted on both thermoplastics and thermosets with good results.

The corrosion resistance of a metal which is deposited on plastic is relatively superior to the identical metal plated on a metal base. This is due to the elimination of electrolytic action between dissimilar metals. In a recent test, silver plated cellulose acetate flashlight reflectors showed no corrosion or tarnishing after 24 hours salt spray and only slight tarnishing after 30 days. The same results were obtained using a reflector made on a phenolic base. In general, plated plastics offer the design engineer a product with the greatest corrosion resistance.

The changing of a non-conductive surface to a conductive surface is accomplished by the application of chemicals. This operation can be accomplished in mass production at low labor cost by either individually spraying

large pieces or tumbling small pieces in bulk. The adhesion of the bond coat is sufficient to allow electroplating of thin deposits which will withstand buffing, wear, shock and variations of temperature.

Masking to prevent the bonding agent from adhering to plastic surfaces which are not to be plated is achieved by several means, including tape, rubber masks and lacquer.

After the bond coat is administered, the work is ready for electroplating. While this procedure is quite similar to electroplating metal on metal, there is need for a limited variation in equipment. While the technique of the metal plating on plastics technique is considerably different from that of plating on metal, the physical principle involved is the same.

In preparing the plastics surface for electroplating, the preliminary treatment of the plastic surface varies a great deal with the plastic. Many procedures are used to insure a grease-free and clean surface which will readily accept the bond and give maximum adhesion of the metal deposit to the plastic.

After the preliminary conductive bond coat has been applied, any metal can be electrodeposited on the plastic. The metals plated on plastics include silver, lead, zinc, cadmium, tin, copper, gold, iron and nickel. The bond coat, a film of microscopic thickness is in itself an excellent conductor which assures speedy and uniform coverage immediately upon immersion in a plating tank.

Finishing Operations

The finishing operations after plating are exactly the same as those applied to metals and the articles can be polished by burnishing, buffing or bright dipping. For example, when applying the plating to a non-conductive decorative piece, it may be necessary to electroplate as high as a .005″ thickness which may take as long as five hours to deposit. The length of electroplating time and needed thickness depends upon the desired lustre of the finished metal. The deposited metal polishes both on hand and automatic buffing equipment. Small objects can be polished in bulk by barrel burnishing. However, where finish or lustre are of no consequence and where the plated surface serves either a mechanical or electrical purpose, the plating can be accomplished in as little as 10 min, thereby reducing plating costs to a bare minimum.

Another variable which materially lowers the cost is the adaptability of the process to plating in barrels. Using this tumbling method of plating, great quantities of small objects can be plated with an absolute minimum of handling and labor.

Any non-conductive material that is not attacked by mild acids or alkalis and has a low water absorption of from 3% to 5% in 24 hours, can be metal plated. Generally speaking, these include most plastics, plastic coated substances, ceramics, glass and impregnated materials.

While there undoubtedly are many applications of metal plating of plastics to be developed through the years, great strides have already been made in the fields of aircraft, automotive, electrical, jewelry, hardware, building construction items, furniture and furnishings, marine, musical instruments, table ware, drug and cosmetic accessories, novelties, office equipment, pens and pencils, etc. Some noteworthy examples in the aircraft field are antenna masts, shielded housings, instrument panels, switch boxes, conduits, structural sections and slip rings. In the electronic and electrical fields metal plating has been used extensively for UHF antennae, wave section guide, special and intricate commutators and shielding on loop antennae, loop antenna housings, panels, batteries and coils. These specific wartime applications are suggestive of many more to come. END

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Recording on Acetate Tape

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IT may safely be said that without plastics recording of sound as accomplished by the new Fonda Tape Recorder would never have been realized. For the entire concept this revolutionary recorder play-back instrument is the electronic recording of sound on either of two plastic tapes—"cellophane" or acetate.

The inventor of this equipment, Jay Fonda, Chief Engineer of Fonda Corporation, was originally a cinematographer, specializing in production and special effects in photography. Fonda became interested in the development of amateur motion pictures and when sound was introduced by the Vitaphone System and the Photographic Sound (R.C.A. & Western Electric Systems), he realized that these systems were too expensive for use by the amateur.

In 1929 he began to experiment with recording sound on film by means of a stylus. From this experimentation sprang the system of embossing a plastic tape as accomplished by the Fonda Recorder. In searching for a cheap and suitable medium to record sound, Fonda experimented with cellophane and acetate tapes and found these to be

the most desirable media for recording after experimenting with various other types of plastics.

He conceived that to accomplish longer playing time, a material such as film or plastic tape would have to be used in order to render continuous uninterrupted recording and to insure permanency, intelligibility of sound, minimum surface noise, and low cost of operation. As it is developed today, the Fonda Recorder records or plays back continuously for up to 8 hours without supervision at a cost of approximately 50c per hour on cellophane and double this rate per hour on acetate.

Impressing on plastic tape which is the principle of recording of the Fonda Recorder, was made possible by the use of a "yieldable felt bed," a simple piece of felt covering the metal bed over which the tape passes—thereby permitting the stylus to impress a groove rather than cut through the tape. This method produces a minimum of surface noise, high frequency response and comparatively long life of the recorded sound groove.

For many years there has been a need for a longer recording period preferably uninterrupted than that offered by discs and one that would be operative at a reduced cost per hour. In 1940 Fonda in cooperation with the Cellophane Division of the E. I. du Pont de Nemours Company, began experiments with cellophane. Two strips of cellophane, .0015" in thickness as used in commercial packaging, were laminated to produce a suitable plastic tape for recording of sound; 350 feet of this tape in an endless loop made it possible to record continuously for up to 8 hours. The tape, approximately 1 7/8" in width, is capable of recording a maximum of 60 sound tracks.

Permanency Far Exceeds Average

From the laboratory tests made by the du Pont Company, the life of cellophane was found to be 21 years which far exceeds the average durability of many types of disc recordings.

Since both cellophane and acetate are cellulose plastics, they have the characteristics of absorbing or exuding moisture when in a humid or dry atmosphere. To overcome and minimize this condition, Fonda after a series of experiments, developed a chemical formula for the treatment of these materials before recording. Tests made in a "torture chamber" from —26° to +60° C and in 95% humidity revealed that both cellophane and acetate lost remarkably little of their original characteristics. The chemical bath devised by Fonda and applied to the tape acted as a seal to the plastic, thereby reducing its absorption or emission of moisture. It also tends to keep the material flexible and produce higher fidelity and a minimum of surface noise as well as prolong the life of the tape.

The acetate film as used is approximately .005" thick and 16 MM in width. The life of the acetate used is approximated by Mr. Fonda to be of the same length as paper made with a rag content and roughly estimated to be a hundred years. Acetate tape is particularly adaptable for this type of recording of music or voice where extremely high fidelity is desired as well as a minimum of surface noise.

The use of plastic may be extended in the post-war designing of the Fonda Recorder. Certain component parts which are now metal may easily be replaced by plastics making the equipment lighter in weight and equally as serviceable. Certainly the adaptability of plastics is virtually unlimited and the singular use of plastic tape as employed in the Fonda Recorder is an outstanding example of the versatility of this material. END

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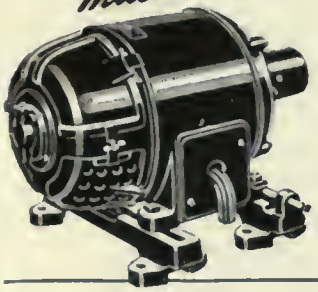

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Airport Landing Lights

(*Continued from page 36*)

use of power conserving light bulbs of 10 w for the runway lights, 25 w for the obstacle lights and only 100 w for the strong beam of the approach light. The effect obtained by integrated molding of two or more vari-colored parts to achieve a multi-colored product predicts further signal lighting applications for marine and aircraft lighting.

Acrylic meets perfectly the rather complicated requirements for an outdoor application of such character as an airport light system. Along with lightness in weight, it has excellent resistance to weathering, is available in either a water clear transparency or a wide range of transparent colors.

Use of the portable lighting system, designated by the United States Army Air Forces as the AN-S-2 field lighting set, is particularly designed for the unusual conditions under which our temporary or advanced air bases often must operate in this global conflict. In addition, even where permanent bases are established, it often becomes necessary to have immediately available, dependable and efficient emergency equipment which is self-sufficient.

More Efficient Illumination

This field lighting set has been developed to meet all these needs, and out of the development has come some interesting lighting improvements. Undoubtedly, the introduction of plastics in this field will have marked influence on further applications and adoptions after the war.

Basically, the set consists of beacon lights, an approach light, marker and obstacle lights, power plant, connecting cables and accessories. For the purposes of this article, however, only the plastic lens units will be described—the approach, marker and obstacle lights, each with a distinct type of lens or filter. It can be emphasized here that these lenses, because of their inherent optical characteristics and built-in design and construction, make it possible to obtain 162-170 cp peak illumination compared with the 65 cp attained with the heavier, 6 lb glass assembly they replaced.

In use, the landing area is laid out along a strip measuring 4200-5200 ft in length and 400 ft in width; of this length 3200 ft constitute the actual runway. The approach light is mounted on an inverted cone and is located on the right side of the runway, its beam projecting with the wind into the direction of approach. The lights are of the tiltable type, each mounted on a cone formed of a plastics impregnated material.

Two Directions for Each Light

The marker lights are arranged in a significant sequence with each color transmitting necessary information to the pilot coming in to land. He is guided by the colors facing with the wind. The coming into the wind the only colors he sees are in this order: The obstacle light with red lenses, two green sections facing him from the yellow and green lens marker lights, four "white" lights from the four clear and amber lens lights, ten clear lens lights placed to project beams in both the upwind and downwind directions, and the amber section of the following four clear-amber lights facing the landing plane. By this arrangement of colors it is possible, in the event landings are to be made from the opposite direction, to automatically provide the same signalling merely through moving the approach light to the opposite end of the field. Since the pilot sees only the color on the side of each runway light facing him, he sees the color signals in their proper se-

quence when approaching in either direction. During battle operations, when lights are hooded, apertures direct confined beams in the direction of the plane approach.

The approach light is really the heart of the system, its tri-colored plastic lens being designed to throw a beam divided into amber, green and red layers for guiding the pilot to a safe landing. It is equipped with a device which projects the tri-colored beam, so that the proper angle of approach is defined by the green beam. A pilot coming in on the amber beam would know he was too high, or if he is on the red beam, too low. The proper approach angle for the particular field is attained by adjusting the angle of the green beam by means of a protractor scale on the side of the projector to correct the angle of light according to various air speeds and rates of descent.

Returning to the lenses which are injection molded, they are so designed to provide a concentrated high candlepower beam at an ascertained angle. Die surfaces have a high finish and angulated contour achieved by a careful precision tooling to bring out through molding the acrylic's high light transmission factor. The marker light lenses are of accurate Fresnel design, elliptical shaped, injected with center sprue in the same mold. The Fresnel design, illuminated with a 10 w lamp filament, throws intense light beams through both ends of the lens, each approximately 5° above the horizontal.

The green-amber lens is in two sections, combined into a single bi-color unit by a special molding technique. The lenses are separated by a sharp color demarkation line, and they accomplish in a single lens a signal combination which would normally require two lamp assemblies. In break tests, results show an irregular fracture without relation to the sharp line of separation between the two colors which are molding compound colors rather than surface dips or stain.

The red obstacle lens is of somewhat different Fresnel design and is parabolic instead of ellipsoidal to produce a light distribution covering its full upper hemisphere. The horizontal distribution is symmetrical, but in any vertical plane the major portion of light is concentrated in a beam extending 15° above the horizon.

No Heat Distortion

The properties of the acrylic lenses in use is better understood when the heat resistance is considered under the condition of 130° ambient temperature. Its interior temperature naturally runs to a much higher degree from the bulbs 1¼" from the lens. No lens distortion results over long periods from the 10 w bulbs in the runway lights even when hooded or from the 25 w bulbs in the obstacle lights uncovered.

The tri-color approach light lens shows evidence of an extremely accurate job of uniting the flat, horizontal plastic panes of three different colors into a single optical lens unit with the surfaces here, as in the other units, approaching optical perfection. Surface dimension of the flat lens is 4$\frac{9}{16}$" by 10" by ⅛" thick. Straight line color strips measure 3" for the amber, $\frac{7}{16}$" for the green, and 1⅛" width for the red, the three being joined to make up the required band in three colors. Sharp line joints between color segments are required, as well as joint strength comparable to an integrated molding. No solvents are used.

In combat areas, the light distribution of the lamp units is restricted by metal hoods and combat "heads." In the case of the approach light, the total beamspread is reduced during combat from 54⅓° width and 22½° depth to 7¼° width and 10¾° depth.

Peacetime industry will undoubtedly utilize such features incorporated in these lenses to exploit the color band and optical possibilities of acrylic plastic. END

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Plastics in Perspective

(*Continued from page* 16)

Still other manufacturers are satisfied to start with the post-war green light by putting pre-war designs back into production, trusting that this will avoid any delay in re-tooling, in obtaining tooling materials and equipment, and in product testing.

War-time developments have been too drastic for any manufacturer to ignore in trying to get back into stride with old designs. Even if he used plastics for his pre-war product, they may not have been used to best advantage.

Many plastics have been applied only in the sense of glamour or with too much regard to price. Such applications—too often misapplications—hang the product and the plastics that go with it. Many molders are outspoken about this problem and they voice the need for designers to get together with them so that the product will be designed for plastics rather than to try to fit the plastics to the design. The designer's ingenuity is much more effective and the use of plastics more effective when the mold design and the properties of the plastic materials are taken into consideration in the product design.

Aggressive designers never lack enthusiasm for plastics application in the redesign of products. Their work on order for manufacturers' reconversion will in itself greatly increase the use of plastics. At the same time, many in the plastics industry feel that from these brand new uses of plastics will come their greatest problems. Merchandising the properties of plastics to "end-users," and designers, they agree, is the way to proper use as well as greater use of plastics.

•

IT is interesting to watch how the use of plastics in combination with more conventional materials draws other industries into closer relation with the plastics industry. And it seems to work to the good of both. Just as one example: The use of paper as a laminate by plastics specialists causes them to study the characteristics of paper. They consult the paper specialists; the paper specialists in turn become concerned about their paper in relation to plastics bonds and impregnates. Pretty soon both the plastics and the paper specialists together are digging for facts from which both eventually benefit.

Plastics closures for glass containers bring the glass and plastics people together. The same example stands for metal and plastics combinations, wood and plastics, fabric and plastics. The number of specialists from other industries formally participating in programs at plastics conventions suggests further examples. One prominent plastics specialist summed it up from the platform at a plastics convention, "Our greatest future lies in the understanding of plastics in use with other materials—not in competition with other materials."

•

THE industry's study of production costs shows an alertness to economics by a comparatively young but fast growing industry. One of the most bothersome of growing pains is conceded to result from a plant's volume growing faster than its cost system. A forthcoming analysis of molders' operating costs and cost distribution is in preparation. The work done on this by the industry is intended to be helpful to all molders and, particularly, before post-war competitive conditions show up the need for knowledge of costs.

•

WHEN your Editor visited a large western molding plant in a "No. 1" labor area, he learned a new refinement in employee relations. The plant president ex-

plained how conscious the entire labor area managements were of employee morale. In most cases they had adopted all of the usual recommendations for convenient and adequate in-plant feeding, excellent working conditions—including "music-while-you-work," etc.

His management went one better. In the tool shop, work is tediously meticulous and, above all, the die makers there are rated as the most critical labor in the whole plant. A die maker works with precision for weeks, and many times months, to produce an intricate die. If he sees that die brought back from the press room for repair or damage, his reaction isn't registerable even on the lowest calibration on the "morale-meter."

But, that doesn't happen at this plant. The damaged die is taken into a special die repair department segregated from the tool shop. The die makers, therefore, never see the dies they produce in any other form than in a state of perfection. Never any damaged dies to damage morale.

●

THE national SPI meeting in Chicago, to start on May 11, rolled up a lot of momentum in advance. Many who had been too busy in their own plants to keep up on the rapid developments in between meetings looked forward to "catching up at Chicago."

Plastics Parts in Radio

(*Continued from page* 33)

This material has the mechanical properties of general purpose phenolic but has a much lower loss factor. Thin sheets of XXX low-loss paper base phenolic laminates are used in many places in the Model SX-28 receiver. Some of these applications are in switch wafers, resistor mounting boards, and insulating supports of variable condensers. Tie lugs, small phenolic strips which are used to support wiring and minor components, are made of XX paper base phenolic. A standard grade of phenolic paper base sheet is used in many other structural applications and is usually fabricated by the cold punch process.

Phenolic impregnated tubing has long been used for radio frequency coil forms. A new technique is now being introduced in the SX-28 whereby these coil forms are molded of BM-120 or BM-262 low-loss mica-filled Bakelite. A screw thread, molded on the inside of these forms, permits easy adjustment of the magnetic core which is made of powdered iron in a Bakelite resin binder. Fixed condensers using mica or paper as a dielectric between the conducting plates are permanently sealed inside a casting of BM-262 low-loss Bakelite. The transparent tuning dials are of Vinylite or of Lamicoid.

Experiments, now underway in the Hallicrafters laboratories and other radionic laboratories, point towards the adoption of more plastic components in the near future. Several uses have been found for extruded plastic tubing such as insulating grommets, "spaghetti" wire covering, etc. Insulated wire which, in former days was largely rubber coated is now becoming available with butyl acetate wraps and neoprene jackets. It is expected that many of these new materials introduced because of war-time necessity will prove far superior to the natural product which they replace.

Most of the applications of plastics such as in the SX-28 communications receiver described are accepted practice and are often taken for granted by the radio engineer. Many revolutionary applications in the field of ultra-high frequencies are, however, in use today in secret equipment. The various forms of polystyrene are proving invaluable in airborne radio equipment and will be equally desirable for other types when the slackening of demand or increased production makes them available. END

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ENGINEERING News Letter

By LEW WINNER

Printing plates have now joined the long list of materials that can be bonded with plastic agents. A new plastic bonding method developed in the Division of Metallurgy as part of a research program sponsored by the Bureau of Engraving and Printing will soon replace the soldering and welding methods used to cement an engraving to a suitable base. Although the older method was effective, it was often necessary to flatten and straighten the welded objects because of distortion under the heat communicated by welding or soldering. The new method, according to government specialists, is expected to overcome this problem. A long series of service tests under adverse conditions have been started. The government specialists believe that the results will be very successful.

The study of plastics suitable for bonding of metal began at the Bureau before the war. Involved in this study were postage stamps, war bonds, government securities and currency reproduction media which require a variety of metal printing plates. The improved method should prove invaluable in raising the standards of production and quality of these vital government plates.

England saw a very early use of plastic metal bonding adhesives with a process called Redux. A similar procedure using vinyl resin solutions was adopted by the Carbide and Carbon Chemicals Corporation in 1941. According to bonding specialists, these modified vinyl resins improved shearing strengths so that it was possible to procure a shearing strength of *5,000 lbs* for metal to metal bonds.

Radia frequency heating has become an important agent in plastic banding technique. A variety of synthetic resin glues have been used. In application, the high frequency heat which may range from 500 watts to 300 kilowatts is applied by inserting a metal sheet between two stacks of wooden sheets (when bonding wood) in the press. This metal sheet is so connected to the power input that an electrical field produces heat between the metal and the press and through the wood.

Many materials, such as cellulose, ceramics, and even ground cork, have been bonded successfully with high frequency heating. The postwar era will undouhtedly see a wide scale adoption of high frequency heating for plastic bonding.

Offset presses and duplicators will probably soon be using plastic ink distributing rollers. For du Pont's Lucrite, acrylic resin has now been incorporated in a roller as a substitute for rubber. Many government agencies in Washington have reported excellent results with these plastic rollers in their duplicating equipment.

Patents Granted

Plastics patent receivers were assigned grants covering materials, machines, molds and processes.

A process of preparing a synthetic resin, which comprises reacting a terpene and a phenol in the presence of a molecular compound of boron trifluoride and separating the resinous products formed from the reaction of the mixture, won a patent for Paul O. Powers of Manheim Township, Lancaster, Pennsylvania. The patent *2,343,845* was assigned to the Armstrong Cork Company.

Theodore F. Bradley, Stamford, Connecticut, received patent 2,345,528 for an air-drying alkyd resin of low acid number consisting essentially of the reaction products of diphentaerythritol, a polycarboxylic acid, and unsaturated oil fatty acids. The patent was assigned to American Cyanamid Company.

Patent 2,343,997 for a stabilized vinyl resin coating was awarded to George M. Powell and William H. McKnight, Charleston, West Virginia. In this patent a coating composition is stabilized against decomposition on heating. This composition comprises an artificial resin containing polymerized vinyl chloride associated with from about 0.5 to about 10 parts of a stabilizing ingredient per 100 parts of the artificial resin. The stabilizing ingredient contains a resin with substantially no basic amino groups. This effect is

achieved from the condensation of formaldehyde with an amide of the group consisting of urea and melamine and from about 0.2 to about 6 parts of an adjuvant material per 100 parts of the artificial resin. This adjuvant material is adapted to prevent reticular formations in the coating on baking. It comprises one of the group consisting of vegetable oils, vegetable oil modified alkyd resins and unmodified alkyd resins.

To Allan Berne-Allen, Jr., af Waynesbora, Virginia, was granted patent 2,343,950 for his development covering a vinyl ester stabilized with an anhydrous ammonium salt of an organic carboxylic acid. The assignment was made to du Pont.

A resin molding patent was received by William Wallace Rowe, Cincinnati, Ohio. The patent *2,343,930* was assigned to Cincinnati Industries. This development covers a process of molding a laminated textured article which includes assembling between a pressing medium. In this medium is a laminated charge with a creped web characterized by minute folds. The surface of one of the pressing surfaces is textured. When the creped web unfolds by expanding, it has a substantially uniform association with a moldable plastic, this plastic being of such nature and in such quantity that the web and the plastic as a unit have the property of plastic flow from regions of high pressure to regions of low pressure in a closed mold.

Kurt E. Ripper, Bronxville, New York, has been awarded a molding composition patent 2,344,733. Mr. Ripper states that this composition is a heat setting material suitable for the production of mold pieces having a high mechanical strength embodying certain component use of glass cloth impregnated with a polymerizable aminoplastic resin. The patent has been assigned to the American Cyanamid Company.

The Eastman Kodak Company has received an assignment of William M. Gearhart's patent 2,343,658, covering a thermoplastic decorative composition and its process of preparation. This process consists of mixing a synthetic thermoplastic resin having limited compatibility in cellulose organic esters with a cellulose organic ester and plasticizer. The amount of the resin is in excess of the maximum solubility of the resin in the plasticized ester. Accordingly, a non-homogeneous mixture is produced resulting in a composition which when molded under heat and pressure presents a nacreous appearance.

A new treatment of crystalline vinylidene chloride polymers was the basis of a patent granted to Ernest H. Harder, Midland, Michigan. The patent, *2,344,511,* was assigned to the Dow Chemical Company. The method involves the treating of a formed article of a crystalline vinylidene chloride polymer possessing orientation parallel to a major surface of the article, which includes the heating of this article to a temperature ranging between its softening point and about 50° C below, while applying a tension short of the breaking load until a permanent elongation is obtained.

Patent *2,345,112,* covering a method of molding plastic layers and conceived by Frantise K. Grundel of Bohemia, has been vested in the office of the Alien Property Custodian. In this patent is included a method for producing raised patterns on the surface of materials. A layer of plastic material is applied on the face of a portion of the form. The area of the form not covered by the layer is then made impervious to the air. The side of the form opposite to that on which the pattern is provided, is subjected to suction. Thus, the layer of plastic material is drawn tightly against the patterned face of the form and an exact impression of the pattern appears in the plastic layer.

The trade-mark Resynthetics has been awarded to the Reichald Chemicals, Inc., Detroit. The trade-mark applies to resins, specifically synthetic resins and processed natural resins; resin solutions, particularly plastic resin solutions. The company claims use of this trade-mark since June 30, 1943.

The Crowe Name Plate and Manufacturing Company, Chicago, has had the word Crowplastic trade-marked. This trade-mark covers thermosetting plastic knobs for radio receivers. The company claims use of this trade-mark since March, 1941. Two other trade-marks have also been awarded to Crowe. These are *Croprest* and *Cra-Art,* the former covering escutcheons for radio instruments made of embossed sheet plastics, while the latter covers tuning units and escutcheons for radio receivers. Both are claimed to have been in use since 1941.

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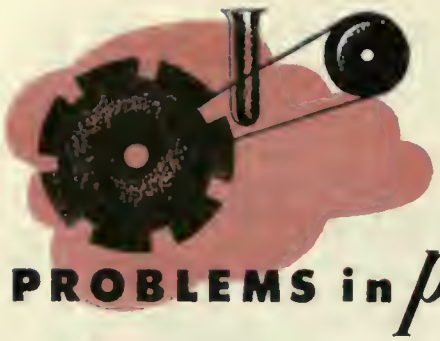

PROBLEMS in *plastics*

Problems and questions may be submitted to this department for answering by the technical editors or specialists in the industry:

What causes the sedimentation from water circulating in Saran Tubing? What can be used to safely flush out and clean the tubing interior? We have on display a female circulatory system reproduced in plastics which appears to be a cellulose acetate tubing (it came from Germany prior to the war). The pigment in the liquid circulated around the system has discolored the tubing interior. What can be done to restore the clarity of this plastics tubing?

R. H., Chicago, Ill.

More information should be available as to the soluble components in the circulating water.

It is suggested that a solution of sodium metasilicate, in the ratio of about 1 oz. per gallon of water be tried in the circulating system.

* * *

Upon removal of large flat phenolic compression moldings, blisters appear on the molded piece. What can be done to remedy this? *S. A. H., Tennessee*

Are the presses opened while the plastic material is hot? If so, try cooling the molds, using water in the heating space, before opening the presses.

Blistering may be caused also by gas trapped in the mold. This may be remedied by:—

1) "Degassing" the mold after initial closing, 2) providing space grooves for gas to escape, 3) preheating material to drive off gas and absorbed water, or 4) closing mold slowly to permit gas to escape.

Blistering can be caused by insufficient pressure or by non-uniform heating remedied by rearranging the channels.

* * *

We have used some surfacing veneers of phenol formaldehyde on wood slide rules, but we have had some difficulty and we are wondering what plastic is commonly used for the surface veneer of slide rules and similar calibrated instruments. *P. R. C., Philadelphia, Pa.*

It is believed that the customary plastic veneer used on slide rules, etc., is cellulose nitrate or acetate. No reason is apparent why phenol formaldehyde couldn't be used.

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usy as we are doing our production bit for the ar, we just can't resist the "end-user" who has problem. To us it's like showing a nice, fresh otprint to a bloodhound. We strain at the ash. Nothing can hold us back. . . . Maybe we pend too much time "talking things out." On ccasion we find ourself recommending a screw achine, a laminated part or a die casting . . . one of which we handle, because we are mold-rs. But, for our peace of mind and reputation, nd the future of the industry, we prefer to be uite frank about what plastics can and can't do.

The "end-user" has been getting under our skin for twenty-six years. His problems have been ours. Many of them we've licked; some we haven't. With every hour of our production working for Uncle Sam, we can't spend as much time as we'd like with our friend the "end-user." But we've packed a lifetime of knowledge of the industry into a mighty helpful 68-page book: "A Ready Reference for Plastics." If you'd like a copy just write on your business letterhead, and one will be mailed post-haste.

**The manufacturer whose product could wholly, or partly, be made from a molded plastic.*

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The application was produced in its entirety by the Dillon-Beck concern. Included was the design and manufacture of metal inserts; tumbling, polishing, and assembly of the nine parts comprising the finished unit and the design and production of a compact packaging which won high praise from military officials.

A series of these case histories is available in booklet form. Write for your free copy of "The D-B Scrap Book."

DILLON-BECK MFG. CO. IRVINGTON, N. J.

ENGINEERS • DESIGNERS • MOLDERS

plastics

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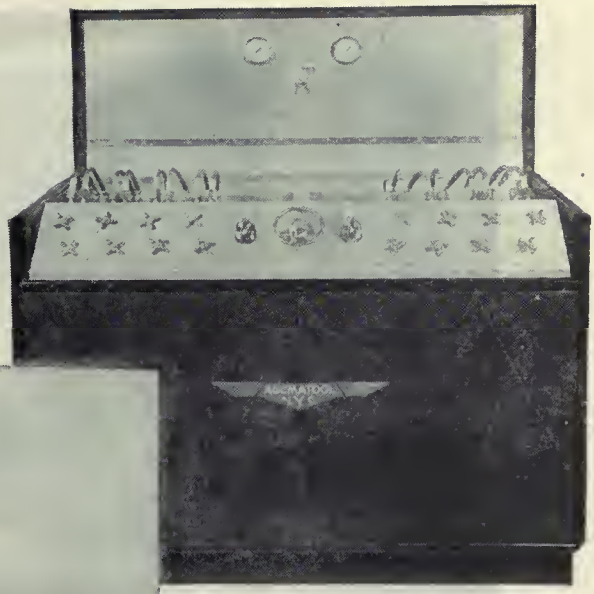

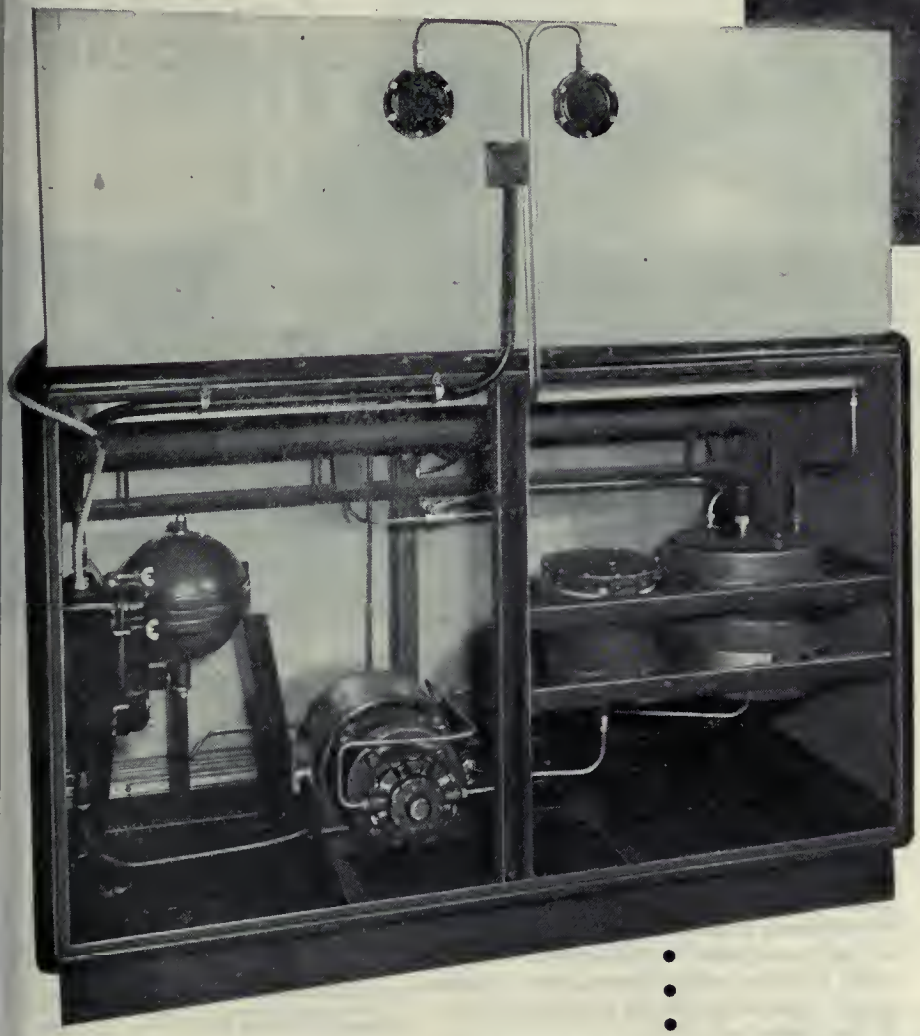

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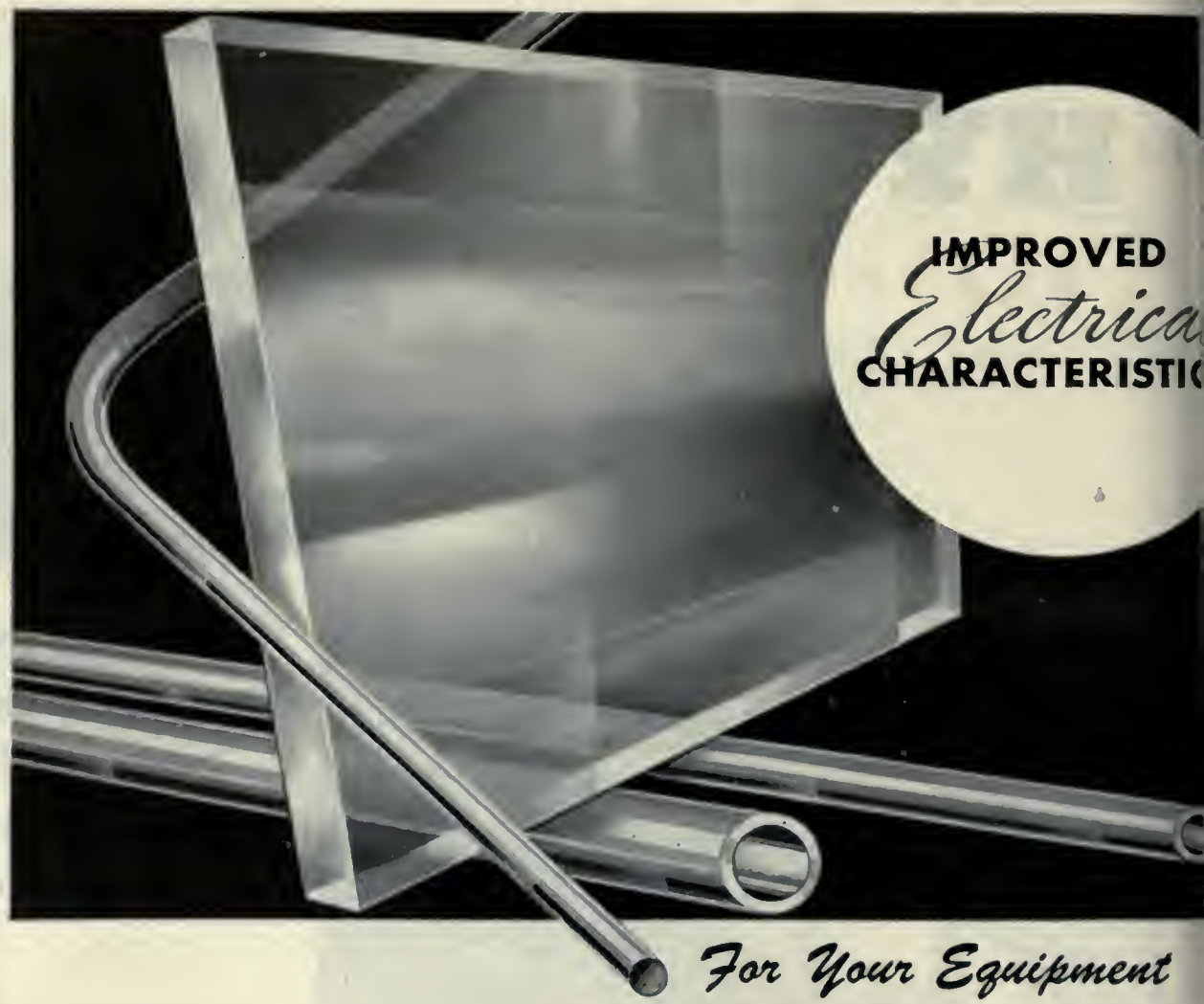

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Possessing unusual electrical *insulating* properties—among many others—Acadia Polystyrene is used as special insulation for radio and other high frequency equipment such as switch boxes, etc. In this role, Polystyrene refines the transmission of the electrical current.

Add to the facts presented here, Acadia's wide experience in the plastics field, and you have the reasons why Acadia Polystyrene merits your investigation.

Complete details are available on request—for quick reference some of Polystyrene's values are given at right:

Dielectric Constant	2.5 to 2.6 at frequen
Power Factor, 60 cycles	.0001 t
10^3 cycles	.0001 t
10^6 cycles	.0001 t
Diel. Strength, Volts/Mil ⅛"...	Short time 50
	Step by step 45
Volume Resistivity, ohms-cms	10
Heat Resistance	150° F. to
Softening Point	190° F. to
Specific Gravity	1.05

Combining a favorable dielectric constant, stren power factor, Acadia Polystyrene is equal to and mica, and *is electrically superior to any ot mercial plastic.*

Consider also the values: zero water absorpti tive freedom from adverse effects by acids, alcohol, stack gases, weather, and etc; an dielectric constant value, and high tensile str 3500 to 5000 lbs. per sq. in.

Write Today

Send for complete data giving physical properties of Acadia Polystyrene, plus a table of specifications on its electrical properties.

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CONTINENTAL CAN COMPANY, Inc.

announces formation of a

PLASTICS DIVISION

Addition of the Reynolds Molded Plastics facilities to new laminated plastic department rounds out service for supplying industry needs

To assure customers of complete facilities in its plastic operations, Continental Can Company, Inc., has acquired the Reynolds Molded Plastics division of Reynolds Spring Company. In addition, Continental has a substantial interest in Marco Chemicals, Inc., producers of MR resins used in the laminated plastic "Marcolite."

To meet the increasing needs of industry now and after the war, Continental has combined its vast research and engineering facilities with those of its new acquisitions. The result is a complete new Plastics Division, fully equipped to handle widely diversified plastic requirements.

The Molded Plastics Department is turning out plastics for a variety of products by compression, extrusion, injection and sheet-forming. Reynolds Molded Plastics—a peacetime producer of plastic parts in the automotive, refrigeration, appliance and other fields—is in Cambridge, Ohio. One of the most modern plastic plants in the United States, it has both ample production capacity and strategic location. It is now turning out important parts for bomber and fighter aircraft.

The Laminated Plastics Department produces the new thermo-setting contact laminate, "Marcolite." This sturdy, light-weight plastic is fabricated in Continental plants in Chicago and Jersey City.

CONTINENTAL CAN COMPANY, INC.

PLASTICS DIVISION

MOLDED PLASTICS:
Reynolds Molded Plastics • Cambridge, Ohio

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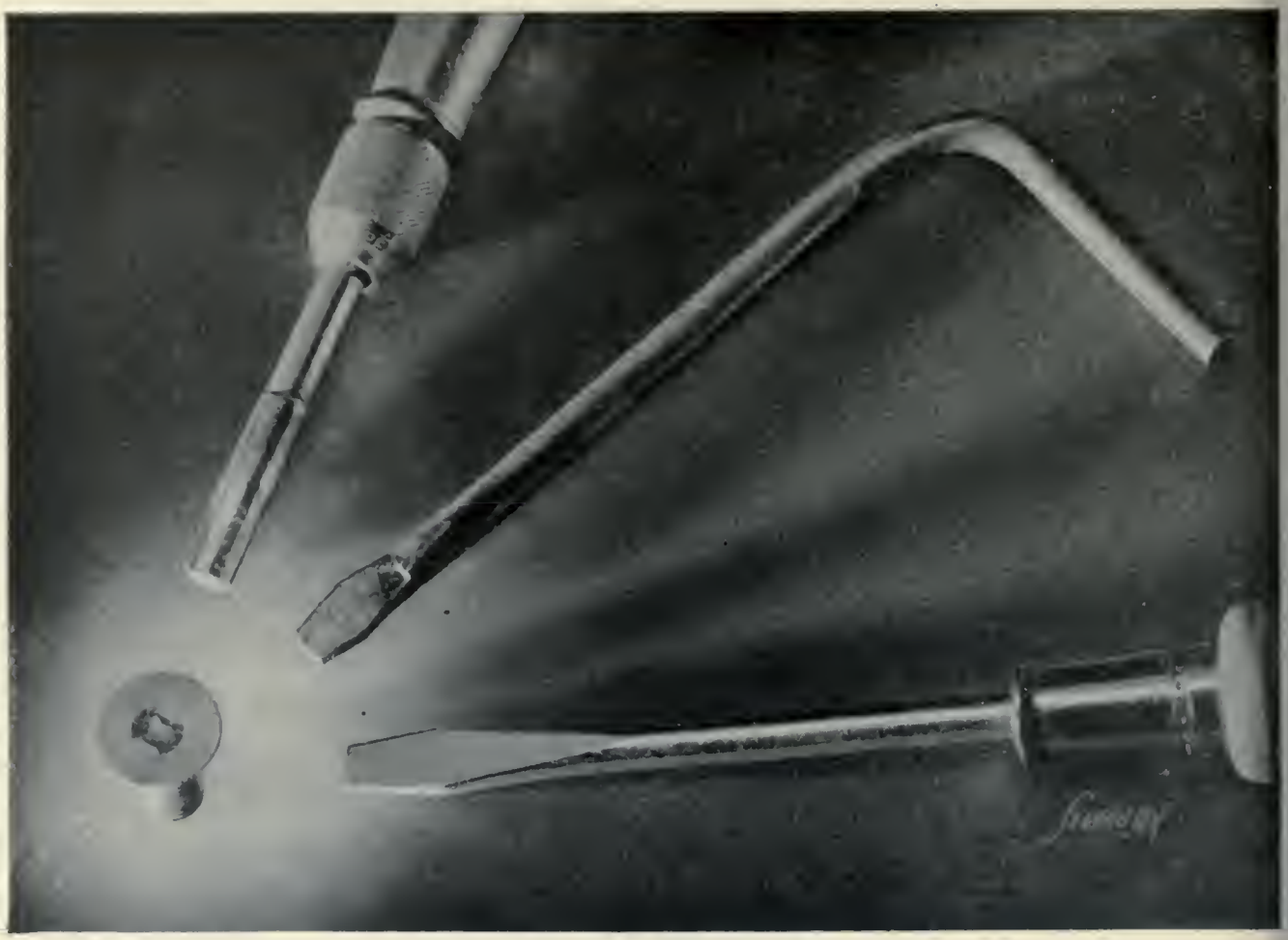
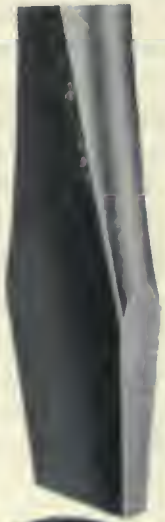
Continental Can Company, Inc. • Chicago
New York • Los Angeles

Continental's Plastics Division is engaged mainly in wartime research and manufacture now. But we're also planning for peacetime products. If you have the necessary priority now or are planning post-war products, we'll be glad to help.

LAMINATION • COMPRESSION • INJECTION • EXTRUSION • SHEET FORMING





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Personally test this feature . . . and the many other exclusive CLUTCH HEAD advantages for faster, safer, and lower-cost production. Ask us *to mail you* package assortment of CLUTCH HEAD Screws and sample of the Type "A" Bit. You will find that CLUTCH HEAD is *The Screw That Sells Itself.*

You may order CLUTCH HEAD Screws in Standard and Thread-forming types for every purpose. Their production is backed by the resources of this Corporation and by those of responsible Licensees.

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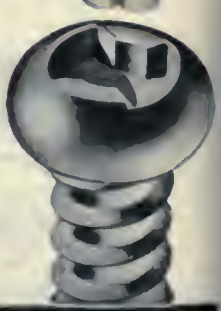
This rugged Type "A" Bit is an important lower-cost item. It delivers longer uninterrupted service and a 60-second application of the end surface to a grinding wheel restores its original efficiency.



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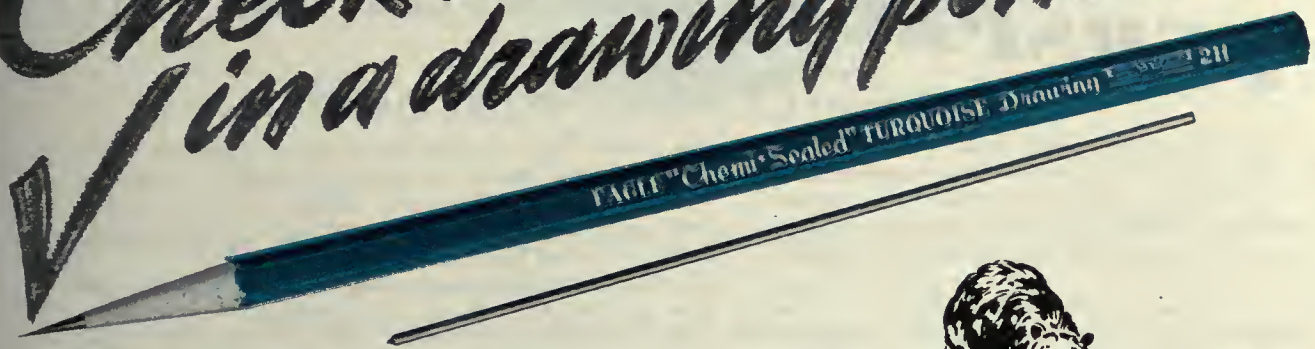

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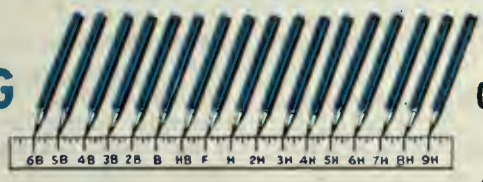

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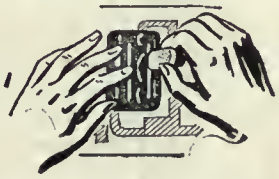

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PLASTICS in PERSPECTIVE . . . . . .

PLASTICS frequently do their bit in helping the sale of goods or products made from other materials. Here is an interesting example described in this issue: new technique utilizing plastics molds makes possible economical production of small-scale models of massive uipment.

Tomorrow's salesman of heavy machinery or other ge units will, in effect, carry his sample of a dredge or am shovel, of a bulldozer or a tractor, in his briefcase!

•

OVERSEAS markets beckon to the plastics industry as they do to other American industries. In its various nifications, the industry is in an exceptional position to ve the peculiar requirements of almost any foreign rket.

A country being rapidly industrialized, such as Brazil, ovides an inviting market for our manufacturing equipnt and basic raw materials for its domestic output of stics goods.

A country such as Mexico, which has both native plass raw materials and which also offers a potential mar: for American consumer goods, can be supplied with nerican industrial equipment as well as finished plastics oducts.

Other markets, for example, Bolivia and Ecuador, offer ple export outlets for a wide range of American plastics nsumer merchandise.

And it must be remembered that South America is not cessarily our main export market. For prior to 1939, al United States exports were about equally divided beeen Europe, South America, and the other world mars.

Unique post-war export possibilities may well be proed in the development of special plastics to meet foreign rket needs. An example of this would be plastics able resist tropical deterioration from fungi, insects, and cteria. Work in this direction is already under way, onsored by the Army and Navy, although strictly for plication to military equipment for the duration.

International competition is tough. And the export field plenty of angles which are different from domestic siness. Export thinking on the part of the industry, refore, should not be superficial, nor should planning export trade be hurried.

•

PRODUCTION of plastics may be still measured only in millions of *pounds*, which may not be impressive en compared to the millions of *tons* in which steel outis recorded.

But impressive indeed are the comparative annual figs since 1929. In that year, this country's production of stics materials was reported at 33 million lbs. By 1935, had reached 95 million. The 1939 output hit a total of million. And in 1943, the estimated output skyrocketed 951 million lbs—an increase of almost 2800% in the 13 years since 1929, or an average annual increase of 214%.

Of this 1943 output, the phenol formaldehyde resins accounted for 283.4 million lbs. Phthalic alkyd resins followed with 147.1 million; while melamine and urea resins were third with 123.6 million lbs.

With new formulations announced almost daily, with new uses projected, it will be interesting to see what the 1944 production records will disclose. What will be the relative position, for example, of ethyl cellulose, with its rapidly developing uses and a comparatively small output of 3.9 million lbs in 1943? And what new plastics may appear in the tabulation for the first time?

•

AS production of plastics soars under stimulus of war demands, down go the prices of several important basic raw materials. Economies effected through the vastly increased wartime output furnish the immediate reason for the recent reductions in the costs of du Pont's nylon molding powder, Rohm & Haas' *Plexiglas*, and Goodrich's *Geon* vinyl resins. But an equally impelling reason for putting the lower costs into effect without delay is to prepare plastics for a sound post-war competitive position against other materials.

And this is exactly what the industry welcomes. For it knows that in many of the wartime applications of plastics, material costs are frequently a secondary consideration to other factors, such as performance, vital in military equipment. With the return of civilian production, however, the question of competitive material costs will loom increasingly larger. By announcing lower costs now, much immediate impetus is given to wider investigation in the use of plastics for post-war products.

•

DISADVANTAGES of plastics materials have a way of disappearing under the pressure of research persistence and genius. (Or are genius and persistence synonymous?)

Here is the Hercules Powder Company with a new form of cellulose nitrate which promises to eliminate the objectionable characteristic of flammability. And also highlighting the news is Monsanto's *Cerex*, a thermoplastic with an unusually high degree of resistance to heat distortion. Both developments are discussed in this issue.

•

IF an editor be permitted to have a favorite child among the departments of his publication, then this editor's choice falls on our "On the Drafting Board" section.

For here, across our desk appears the shape of plastics things to come, reflected in the keen, yet sound imagination of many young designers who have accepted plastics as their favorite medium.

And although we frequently temper the imagination with an insistent, *"Why* have you chosen plastics for this design?", we never—well, hardly ever—quench the enthusiasm of the designer. —A. E. J.

An Open Letter and Invitation to

Tool and Die Makers Who Have Shop Problems

- Several years ago Kearney & Trecker began helping tool and die makers with their shop problems whenever they'd write in asking as to the best method of producing a particular tool or die. These requests for help included the making of plastic molds — forging, die casting, stamping, and drawing dies. In fact, they covered the whole tool and die field.

- In many cases our Model D Rotary Head Miller would handle the job to perfection — in other instances, after looking at the blueprints, we'd recommend some other method of producing the tool or die that was troubling them.

- Because of the extreme pressure which all of us were working under at that time, we didn't publicize the fact that such service was available. BUT . . . now we have set up facilities in our Tool and Die Department which will enable us to give you *prompt* advice without obligation, as to the fastest, cheapest way to do the job.

- If our Model D Rotary Head Miller is, in our judgment, the best bet for producing it — we'll tell you. In fact, we'll even make the job for you at a *very nominal cost* here in our own Tool and Die Department. What's more, we'd welcome having one of your men come to the plant to watch us make it.

- *If,* on the other hand, we feel that there's a better method of producing the tool or die — we'll return your blueprints with our recommendations. Fair enough?

If you're interested — write Tool and Die Division, Kearney & Trecker Products Corp., Milwaukee 14, Wis.

Kearney & Trecker Products
CORPORATION

Plastic COUPLINGS

Molded by the Millions

ABOVE: Plastic coupling parts coming from one of many injection molding machines in the Amos plant. BELOW: Parts being inspected and trimmed, ready for assembly.

If all the plastic couplings molded by Amos were used to join 50-foot lengths of hose into a single line, we could turn on the hydrant here and sprinkle water on the desert land of central Australia—and still have some extra hose sections for side excursions . . . Plastic hose-couplings are units of three separate pieces—all molded by the extra fast and efficient injection process. This is but another example of what Amos does for many different companies who appreciate the quality, economy and colorful sales appeal of molded plastics.

* * *

Many a product engineer is planning now to redesign parts and products for plastics—to meet the flood of business after the war. For such men, Amos has prepared an informative booklet of general information and technical data. You need only to write for your copy of "Will You Use Plastics?" It's free. No obligation. Just address . . AMOS MOLDED PLASTICS, EDINBURGH, INDIANA • Division of Amos-Thompson Corporation

Amos

MOLDED PLASTICS...

Custom Molders of Parts and Products by the Injection Process

Here are a few of the plastics items for which premium distributors paid $25,000,000 a year

Premium Goods Offer Large Post-War Volume

By

Frank H. Waggoner

Editor of Premium Practice & Business Promotion for 25 years, Mr. Waggoner is often consulted on how to conduct premium campaigns, is an expert, too, on the legal phases of the subject

Premium Field is Held Ready to Absorb $50,000,000 of Plastics Products Annually After the War

WHEN one speaks of the field of premiums there comes up the vision of coupons and a miscellaneous array of small items unless one has taken time to become familiar with premium distribution as an established, stable market for a large volume of manufactured items. To the uninitiated it may come as a surprise to learn that in the years before the war, premium distributors spent more than $400,000,000 a year for the manufactured items they distributed. The retail value of this merchandise was at least one billion dollars.

The effect of premiums combined with sales of sponsoring products can well be imagined. On the authority of one analyst, premiums have been the motivating factor in the sales of $13,000,000,000 worth of merchandise a year.

Few, if any, methods of advertising and sales promotion have equaled the medium of premiums in the rapid expansion of businesses that sponsored their use. The growth of premium use has reflected the public's acceptance of this form of merchandise. When the war is over, and premium merchandise is again to be had, there should

These Lumarith desk accessories can be put to work introducing new post-war products and recruiting buyers for standard items

be, in the opinion of both premium users and the manufacturers of premiums, a great revival of premium use, reaching a volume never before attained.

Prior to the war, when plastics were just beginning to hit their stride, it is estimated that out of the $400,000,000 spent annually for premiums, the volume of plastics sales were at least $25,000,000.

Premium campaigns frequently absorb quantities unheard of in any other field. They often make it necessary that the order be split up among a number of factories so that the required aggregate may be on hand at the appointed time. Here is one example of premiums as a volume outlet: The initial order for cereal bowls to spearhead the introduction of a new cereal was 5,000,000, and that alone accounted for the sale of 10,000,000 packages of the product.

Plastic bathroom tumblers, in pastel shades, by the hundreds and hundreds of thousands found their way into bathrooms all over the land, and along with them a

Prejudice against use of butter substitutes could be countered by supplying molds to shape the conventional quarter pound bar

well known make of tooth paste got wide distri

Measuring spoons for coffee, given free with p chase of a pound of the sponsoring brand, hav used in box car figures. Spoons in all sizes a varied uses have been used by the millions in the agg

The introduction of the clear plastics was i welcomed by premium users and salad forks and cake and vegetable slicing knives were among th items that were promptly utilized. Novelty items, ci cases, compartment boxes and others for a var uses were beginning to be used when the war inte

Jewelry, long one of the successful premium gave full play to the use of plastics, especially novelty class, until it too felt the impact of the war. and games represent another class in which plastic making great strides.

We must go back to the astronomical figure clas we mention the millions of buttons, badges, emble other tokens of membership in one juvenile organ after another, promoted usually by manufacture products used by boys and girls.

Plastics found growing favor with premium as parts of other products, in office and desk acce cases for clocks, radio cabinets and others almost w end.

There has been no attempt other than to sketch of the highlights in the prewar use of plastics. war effort, plastics and their uses have made an a comparable to a decade or more of peace. W processes of production in line after line have oper unlimited new applications of plastics. To the l the progress has been staggering in its scope a complishment. And the premium field is only o the many in which the plastics industry is undo on the verge of significant developments.

The Post-War Picture

What are the opportunities for plastics in the po premium field?

The field and range appear practically unlimited. is because the accepted answer to the question makes a good premium?" is always "Wanted merchan Measured by that yardstick, plastics in the post-w have a premium opportunity unrivalled in the hist the industry. To the extent the industry can p "wanted merchandise" the oyster is theirs.

In discussing with leading premium users their a toward an expanding use of plastics as premiums they become available, there was an eagerness man to see the new developments in plastics just as s possible, and with no attempt to limit the possible

But typical was the point stressed by a buyer certain large volume user of premiums. Emph that he knew practically nothing of the many di types of plastics and their many different propert brought out that he would have to depend on the to submit only such plastics items as would eq surpass in performance similar items made of materials.

Another buyer was keen to compare plastics tab with china and glass, particularly cups and sauc well as tumblers, pitchers, and various small item on the dining table and in the kitchen.

The head of the premium department of one prominent advertising agencies whose preferenc toward jewelry and toys, believes that plastics marvelous future in those lines.

Without exception there was a favorable predisp

(*Continued on page* 88)

Inflated Vinylite In Furniture Design

By William E. Meissner

Engineering Development Department
Gallowhur Chemical Corporation

Low-Cost Lounge Chair for Outdoor or Home Use can be Mass-Produced from Heat-Sealed Elastic Tubing and a Simple Plywood Frame

TWO years ago, if anyone had suggested that we would one day be in the furniture business, we would have thought the idea far-fetched, to say the least. Today, it looks as if we were actually heading into direct manufacture of furniture, or at least into close association with that field. And behind that is the story of a new type of inflated plastics chair which we have developed during the past 18 months.

Startlingly enough, the origin of this chair, which we believe is likely to break ground in the industry, lay in work we were doing for the U.S. Maritime Service on Sunstill—a still to make drinking water from sea or contaminated water, using solar heat to effect evaporation. Details of this particular device cannot be divulged as yet, except that it employs elastoplastics.

Assigned to us by the Government in the development and design of this device was William Miller, who, before joining the service, studied industrial design at the Franklin School of Professional Arts in New York. In the course of this work, he conceived the idea of using the same elastoplastic material for a chair. Before long, this idea developed into experimental models, one of which is shown in Fig. 1.

The essential part of this chair is a vinylite tube made from sheeting about 0.020" thick, which is heat-sealed. Blown up with air, it becomes both cushion and frame. A bicycle pump may be used for the initial inflation, though it can easily be done by mouth since only 1½ lbs pressure is needed within the tube. The tube can be inflated to any degree of hardness or softness desired. Once filled, it allows very little air to escape. The material is decidedly tough, but should someone take a notion to puncture it with a sharp point, the hole can be patched with a vinylite solution. Wooden legs screwed into a wooden mounting ring and a canvas seat complete a slump chair which is easily collapsible and portable. Production is possible on a mass basis, with practically no assembly cost.

Fig. 2 shows an improved design of laminated plywood which was on display in the industrial part of the recent exhibition at the Museum of Modern Art, described elsewhere in this issue. With a curved mounting for the tube

(*Continued on page* 101)

Fig. 1. An early model showing tube mounted on a wooden ring and covered with canvas

Fig. 2. Later model, which is mounted on laminated plywood, has metal legs, fishnet cover

Extruding Thermoset Materials

By Kenneth R. Porter
Plastics' London Correspondent

New British Method Achieves Variety of Beaded, Bent and Curved Sections, also Tubes of Up to Six-Inch Diameters

THE possibilities of the extrusion method of molding have long been recognized by manufacturers and users of plastics products in Britain. The first developments in this particular field were the thermoplastics, such as cellulose acetate, ethyl cellulose, and polyvinyl chloride, and the general possibilities with materials of this type are fairly well known.

Somewhat less known are the present-day possibilities of the thermosetting compounds, particularly of the phenolic type. Considerable progress has been made in recent years in the improvement of the technique for producing sections in continuous lengths from such materials, although the exigencies of war-time have not permitted development for purely civilian uses in domestic spheres. Nevertheless progress has been made and there are a few applications in which mass production is now possible.

The extrusion process is specially suitable for the production of a wide variety of sections that could not be made commercially practicable by any other method, at least in long lengths. In actual practice there need be no limit to the length of an extruded section in thermosetting material, whether it is a phenolic or an urea base, although there are limits to the size of the cross-section. One of the largest tube sections that has been mass produced by this process is some 6" in diameter with a wall thickness of approximately ⅜", which has been in use for a considerable time for the Gestetner duplicating machine roller.

The domestic purposes for which widest use has been made of extrusions has been for curtain runners, comprising both single and double running tracks. Another particularly interesting item is a box section 57 mm. square by 1.7 mm. wall thickness, specially produced as a gas cooker regulator cover.

A tubular section in a variety of colors has proven very popular for kettle handles, this being a use where the low heat conductivity of the material is of special importance. For this purpose the most adaptable section is a round tube 25 mm. by 21 mm., or an octagonal tube approximately the same size. Tubular sections in different colors have also been in great demand as towel rails and the color range makes a special appeal.

Lamp standards, both for table and floor, have been made up from extruded tubular sections, this being an instance where the wide scope of the process can be successfully exploited owing to the variety of profiles which are possible. For these lamp base sections the exterior may be round, square, octagonal or fluted, whereas the bore in each case may be circular. Beading sections for table edges, mirror and window frames and similar purposes have also been produced.

In this lamp base the extruded tube has the octagonal exterior more clearly seen in the cut piece at left

Curved Extrusion Operations

A use for which these sections are very suitable is for electric wire ducting where the insulating properties allied to the extensive range of internal profiles can provide separate channels for various types of electrical conductors. In addition, the color scheme possibilities make such sections particularly practical.

There is, broadly speaking, no limit to the possibilities of tube sections where, to meet special requirements, either the bore or the exterior or both can be produced in special profile shapes.

From the color angle, mottles, as well as plain colors are practicable to very much the same extent as compression-molded color variations.

When the continuous extrusion of thermosetting plastics materials was first developed it was not possible to produce commercially other than straight lengths. Intensive work over the last few years has resulted in the practical production of bent and curved sections, a process having now been perfected whereby bending takes place during the actual extrusion, before the final curing of the material

s completed. For obvious reasons there are limitations s to the degree of bending which can be obtained, this eing dependent on the actual cross-section concerned, ut a satisfactory bend can be effected to a radius approxinately fifteen times the tube diameter. For example, a ube with a 1" outside diameter could, by this new technique, be bent to a radius of 15".

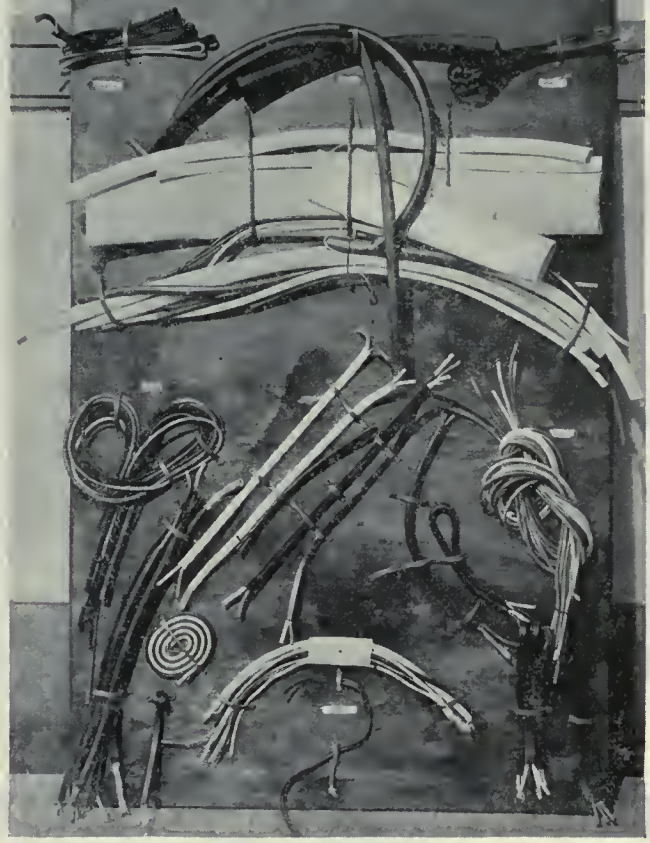
Extruded Plumbing Duct

War-time exigencies have held up developments of hermoplastics for purely domestic requirements but the greater flexibility and the wider color range which are possible with this class of material make a variety of sections especially attractive. Here again curtain runners have been an important outlet. Many hundreds of thousands of feet, mainly in cellulose acetate, have been manufactured for this purpose in England, particularly in an H section where the dimensional instability of acetate in varying atmospheric conditions is largely nullified.

The different degrees of flexibility possible with thermoplastics give greater ease of manipulation and consequently various sections, especially beadings, have been put to special uses where corners have to be negotiated.

A field for domestic use in which sections in both thermosetting and thermoplastic materials are and will be of growing importance is for plumbing systems. So far as the former class is concerned an extensive range of tube sizes is possible for the convenience of hot and cold water and many thousands of feet have been in use for some time as flushing pipes and also as waste pipes from hand-basins. Certain types of thermoplastics, more particularly the polyvinyl chlorides in fairly rigid form, are in great demand for the conveyance of cold water since tubing made from these materials can be shaped and bent on the site with reasonable facility and can also be jointed by comparatively simple processes; not altogether unlike those in use for many years with metal pipes.

In this application it should be remembered that the thermal resistance of practically all types of thermoplastics in general use is comparatively low, somewhere between 40°-60° C. Consequently their use for pipes for the conveyance of domestic water is still very limited. The greatest attraction, however, of both the thermosetting and thermoplastic plumbing pipes is their almost absolute freedom from corrosion and the consequent advantage over most types of metal piping in districts where the domestic water supply is of the "hard" variety.



Extruded tubings used as conduit material in place of metal figure prominently in the assortment above

It is fairly certain that in the immediate post-war years the scope of extruded sections in plastics materials can be and will be widely extended, not as a rather doubtful "substitute" for old time materials, but as a fully serviceable or better still, complementary product to the standard types in use now. There is ample room, particularly during the post-war building period, for both the old and newer products to be used either separately or together so that the fullest possible advantages of each are utilized. END

Single and double track curtain runners are largest home outlet for extruded tubing in England

Abstraction in line is a keynote for display of these laminated articles in the exhibition

Influence of Plastics Stressed in Museum Show

THE technology of modern plastics is credited with being "possibly the greatest single influence on the shape of modern useful products" by Serge Chermayeff and Rene d'Harnoncourt in the catalog of the 15th anniversary exhibition of the Museum of Modern Art, New York. That statement is also posted on the walls of the museum, where it cannot fail to impress the tens of thousands of visitors expected to attend.

What they mean is that plastics, as a wholly new type of material, has stimulated designers to make a fresh start, whatever the product they are concerned with happens to be, rather than to imitate something which has been made previously in another material.

"The lack of conspicuous structure in synthetic plastics," they go on to say, "and the ease with which uninterrupted flowing surfaces can be produced by molding have given us a new range of compact curvilinear forms that are expressive of the flexibility of the material."

Messrs. Chermayeff and d'Harnoncourt also sound the warning, which is likewise a challenge, that the very ease with which plastics can be handled is "a danger as well as an asset, since an even greater integrity and discipline is required of the designer if extravagance can be indulged in so easily and without additional cost."

The exhibition is arranged so as to bring out these ideas graphically. In a display of tumblers, flasks, plates, pitchers, etc., made of glass, pottery, metals or plastics, it is plain that plastics are simply an alternative practicable material for these objects.

On the other hand, there are such articles as the inflated vinylite chair (discussed in a separate article in this issue) which do not depend on precedent for their design because the material is without precedent. That is to say, plastics are no longer treated merely as a substitute for glass or pottery or metal but as a material having its own unique properties on which, together with its use, its design must be based.

Throughout the exhibition, such functional design is pointed up as worthy of emulation, while imitative design is called into question. For example, the cathedral motif of an early model of radio housing is contrasted with the one illustrated here which makes no concession to conventional themes. It achieves its decorative effect—and a striking one it is—incidentally to its primary purpose, which is to make the best possible receiving instrument within the imposed limits of size.

The industrial products and consumer articles in plastics and other materials are grouped in a section called "New Design," as part of a larger exhibition of painting, sculpture, architecture, photography, and dance and theater design.

A variety of plastics materials is embodied in the diverse objects on display, which range in size from a knob to a boat. Many of them, like the airplane parts, plumbing fixtures, safety razors, binocular case and navy mess ware, are familiar. Some, like the plywood boat hull described in detail in another article, have been more heard about than seen. And there are also decided novelties, such as the inflated vinylite chair which is also the subject of a separate article, a sun hat of the same material designed by the same man, plastic sculpture, and transparent boxes put to a number of new uses.

Wall coverings and screens, impregnated papers and woods, a jettison fuel tank, sheetings and laminated veneers, surgical splints, plants and shells decoratively imbedded in methacrylate blocks, head hammers and juicers —these give an idea of the range of the exhibits.

The only factor not sufficiently taken into account is color. In view of the interesting designer's model on display made of vari-colored plastic sheets and wire, it is odd that there should be so few end products illustrating the

hese flowing surfaces illustrate the ew beauty inherent in plastics design

Exhibit Urges Freshness, Originality in Design for Objects in New Medium Rather than Acceptance of Old Forms

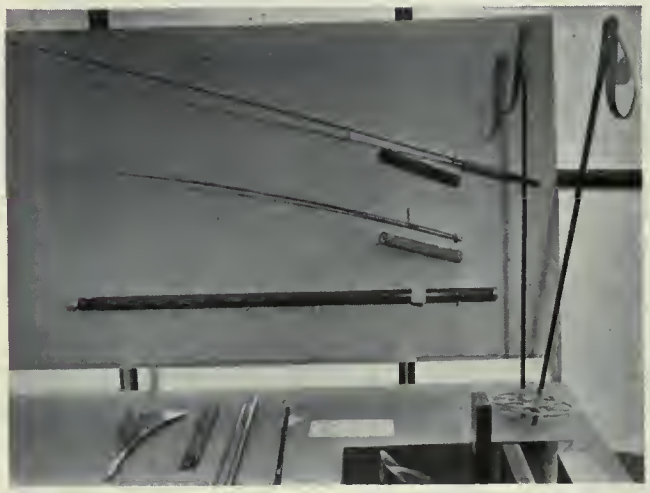
olor possibilities of plastics currently being exploited.

Among the companies participating in the show, whether s materials sources, fabricators and manufacturers are: he Bakelite Corp., Catalin Corp. of America, Celanese ellulose Corp., Columbian Rope Co., Dow Chemical Co., Masonite Corp., Monsanto Chemical Co., National Carbide Corp., Rohm & Haas Co., and Tennessee Eastman Corp. Also: National Die Casting Sales Corp., Dazey Corp., Watertown Mfg. Co., Bryant Electric Co., R & R Plastics Products Co., Dillon-Beck Mfg. Co., Kadette Radio Co., Philco Radio & Television Corp., California Institute of Technology, U. S. Plywood Corp., Evans Products Co., Marine-Air Research Corp., Fairchild Engine and Airplane Corp., St. Regis Paper Co., Vidal Research Corp., Glenn L. Martin Co., McDonnell Aircraft Corp., Wm. L. Marshall, Swedlow Aeroplastics, Marsh Wall Products, nc., Charles F. Orvis Co., Elmer E. Mills Corp., Hood Rubber Co., Duranol Products, Bill De Witt Baits, Polaroid Corp., Kurz-Kasch Co., Hughes Autograph Brush Co., Auburn Button Works, Henry A. Enrich & Co., General Electric Co., American Insulator Co., Amos Molded Plastics, Curvlite Products Co., Richard Delano, Dr. Charles E. Sando.

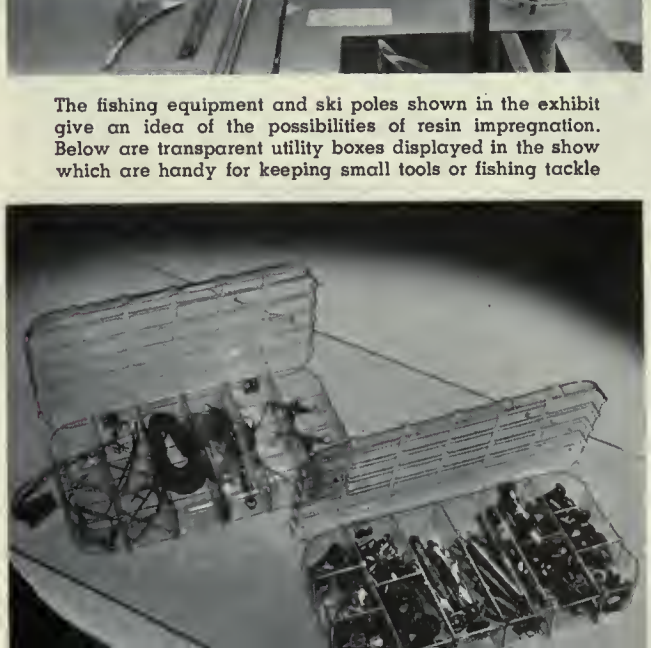
Among the designers represented—designing engineers being anonymous as usual—are: Barnes & Reinecke, George Patterson, Ray and Charles Eames and L. J. Marhoefer.

"New Design," fourth exhibition of its kind held by the museum as part of its program to foster sound design in machine-made articles for consumer use, emphasizes plastics much more than its predecessors did. Mr. Chermayeff, chairman, Department of Design, Brooklyn College, assembled and installed the current show, together with Mr. d'Harnoncourt, director, Department of Manual Design of the museum.

The exhibition opened on May 24 and will continue throughout the summer. END



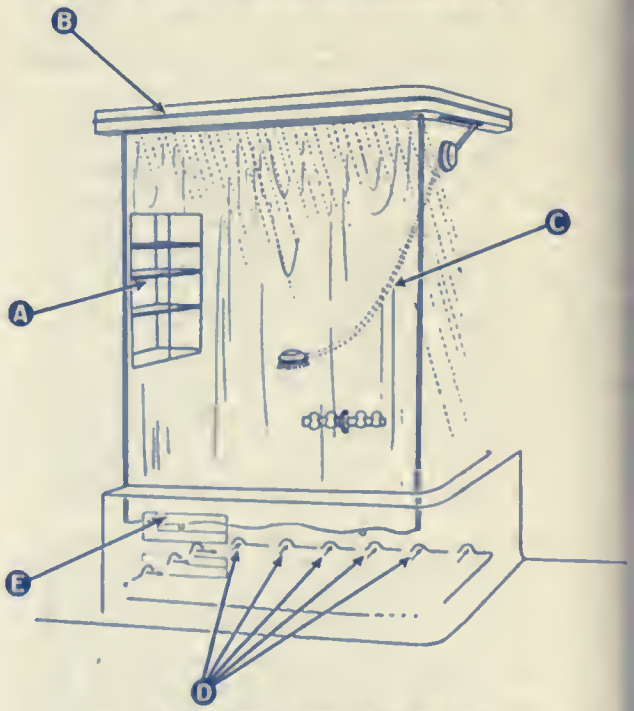
The fishing equipment and ski poles shown in the exhibit give an idea of the possibilities of resin impregnation. Below are transparent utility boxes displayed in the show which are handy for keeping small tools or fishing tackle



Plastics IN THE MODERN HOME

An Analysis of the Cost and Performance of Plastics and Competing Materials for the Manufacture of Large-Sized Functional Household Equipment for the Post-War Consumer

The bathroom offers many applications—from the tub pictured at left to the devices diagrammed below



A Towel and accessories cabinet
B Shower curtain rolls out of way
C Spot spray of plastic tubing
D Multiple inlets and outlets
E Outside recess for soap, brush

By Frederick Z. Pearson

Manager, Plastics Division
Lyon Metal Products, Inc.

THE purpose of this article is to present an unbiased analysis of the possibilities of plastics for structural applications in relation to other raw materials. It represents the results of a broad study that can be covered only partially here. The subject stressed will be *the mobile equipment of the home,* especially the larger sized units which require superior structural strength.

The immense variety of structural plastics materials makes it difficult for the product designer to decide readily if plastics shall be used and which ones. This is especially true with respect to the economic status of his products in the highly competitive post-war period that is anticipated. We now possess facilities to produce more of the various raw materials than we have ever used before this war. Intense competition for applications and markets will result. It is of the utmost importance that we select materials and manufacturing processes intelligently so that in turn our fabricated products will have a favorable competitive standing. Superior performance at lowest cost is what puts a product ahead of its competitors.

Underlying the design of any product are specifications which the product must meet. These automatically narrow down the list of alternate raw materials to be employed. From that point on, the rule of maximum performance balanced intelligently with lowest cost leads directly to the best choice.

Structural characteristics in plastics materials can best be obtained from a combination of high strength fillers and resins. The resins by themselves lack the necessary tensile, flexural and impact strength, dimensional stability, surface hardness, etc., all factors of prime importance in a structural material.

To all practical purposes, out of the enormous variety of plastics materials only one broad group, the laminated plastics, adequately meets structural requirements. Also, the plastics resins to be used narrow down to the thermosetting group, although laminates, employing thermoplastic resins have been made. The basic advantages of thermosetting resins over most thermoplastics for structural applications are higher heat resistance and stability under continuous heat, better surface hardness, lower coefficient of expansion, and absence of cold flow. The result of these is better dimensional stability and usually lower cost.

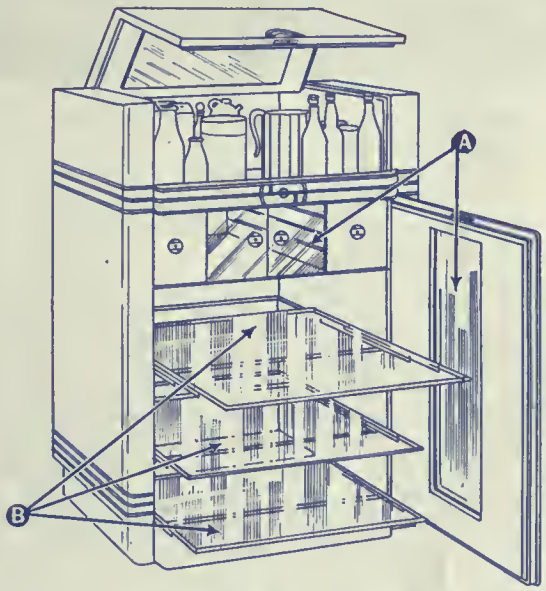
The laminates sub-divide in different ways according to the basis used for comparison. Based on the *reinforcing fibers* used:

Wood Fibers
  Plywood, paper and pulp
Vegetable Fibers
  Cotton, hemp, ramie, sisal and flax
Artificial Fibers
  Glass and rayon
Mineral Fillers
  Asbestos-paper and asbestos-cloth

On the basis of *manufacturing techniques,* we can subdivide the structural plastics into:

1. The conventional *laminates,* consisting of multiple layers of resin-treated paper, cloth, etc., combined under high heat and pressure. For deep moldings, creped paper and cloth are usually preferred.
2. The *low pressure laminates,* built up in similar manner, but produced under considerably lower pressure, sometimes lower heat and in many instances without

The pulp molding process makes possible the forming of large units such as the refrigerator illustrated here in external view (above) and internal view (below)



A Transparent door to fresh vegetable chamber and transparent panel in outer door of box itself

B Series of removable transparent trays which slide in and out on telescoping ball bearing supports

Plastics impregnation of paper pulp, a new wartime development, promises moldings in large and intricate shapes. Above, the worker mixes pulp and synthetic resin. Below, impresston molds and a finished ptece

solid dies, employing rubber bags, or other pliable material.

3. The *no-pressure laminates*, generally similar to the second group with the exception of pressure not being essential for proper manufacture and sometimes heat being unnecessary.
4. *Pulp molding*, using fibrous preforms that closely conform to the dimensions of the finished product, impregnated with resin and molded to final dimensions.

The *paper base laminates* are outstanding in providing decorative possibilities, because they are well adapted to incorporate the many beautiful effects developed in the printing industry. Inlays in several colors, eventually with metal bands and also fluorescent patterns have been made.

In purely structural applications, high strength sulfide-paper-base plastics provide high tensile and flexural strength at low cost. In design and fabrication, however, it must be kept in mind that the lack of stretch, inherent in paper, is a limiting factor with regard to the curvatures possible, and this also influences the cost of production.

The creped paper base materials are a partial answer to this problem. The impact strength of the paper base materials is not on a par with the cloth base laminates, a condition that tends to limit their application to parts that are relatively free from rugged handling. The fabric base laminates are to be preferred where severe shocks and impact, as well as superior machinability are desired. They are also superior in their adaptability to deep drawn moldings. A typical application is the Army helmet liner, where highest impact strength and deep forming characteristics were essential.

The *low pressure laminates* and no-pressure materials, generally are applicable to the same type of product as the conventional cloth base laminates, but have the added advantage that small quantities are not an unfavorable production factor because the tool costs are very low.

Post forming is a new technique which allows flat sheets, laminated by conventional methods, (and therefore reasonable in cost,) to be formed into simple shapes and shallow draws with methods similar to the forming of metals. This process has application in simple shapes but does not contribute the major advantage of all plastics, the possibility of molding finished parts that do not require additional assembly work.

The *plastics molded plywoods* find their application principally in very large structures which are out of range of most presently available press equipment and in cases where expensive molds and presses are not warranted by the number of pieces required. Small boats, most aircraft assemblies including primary structures, certain items of furniture, station-wagons and other specialized transport-vehicle bodies are good prospects for this material. Plywood, in particular, is to be preferred where maximum strength for minimum weight is more important than lowest cost.

Pulp molding is a new combination of plastics resins with an old technique, long used in the manufacture of papier-mache products. It may well become a major branch of the plastics industry, just as the combination of plastics with wood, paper and textiles established the basic laminating industries.

In complex curved laminated moldings, no satisfactory way has yet been found to eliminate the mating lines of the patterned cloth or paper laminations. These are visible in the finished part unless it is black in color or paint-finished after molding. This defeats a fundamental advantage of plastics, a permanent molded finish. Pulp molding offers this uninterrupted solid finish plus a combination of other desirable characteristics such as low cost, high strength, almost unlimited curvature allowed in product design, variations in wall thickness easily accomplished, inserts safely anchored and rapid production on a semi-automatic basis.

Now these structural plastics materials must prove their merit in competition with such structural materials as:

Metals	Steel, with oven baked finishes
	Aluminum, eventually alumilited (oxidized skin)
	Magnesium
	Stainless steel
	Cast iron enameled
Wood Materials	Plywoods
	Hard boards
	Vulcanized fibre
Other Materials	Glass, ceramics, etc.

For most mass produced merchandise, standard steel excels the other metals by a considerable margin because it provides far more strength per dollar than its colleagues. In many designs, however, special characteristics are more important than the economic considerations and in such cases other materials will be preferred. For example, *lightness* in aircraft construction designates alumi-

(*Continued on page* 98)

FOR GOOD MEASURE

MANOMETERS equipped with shatterproof Tenite tubing are rugged, accurate instruments. A demand for unbreakable gages for measuring pressures of boilers and air-conditioning units led to the replacement of glass tubing by transparent Tenite.

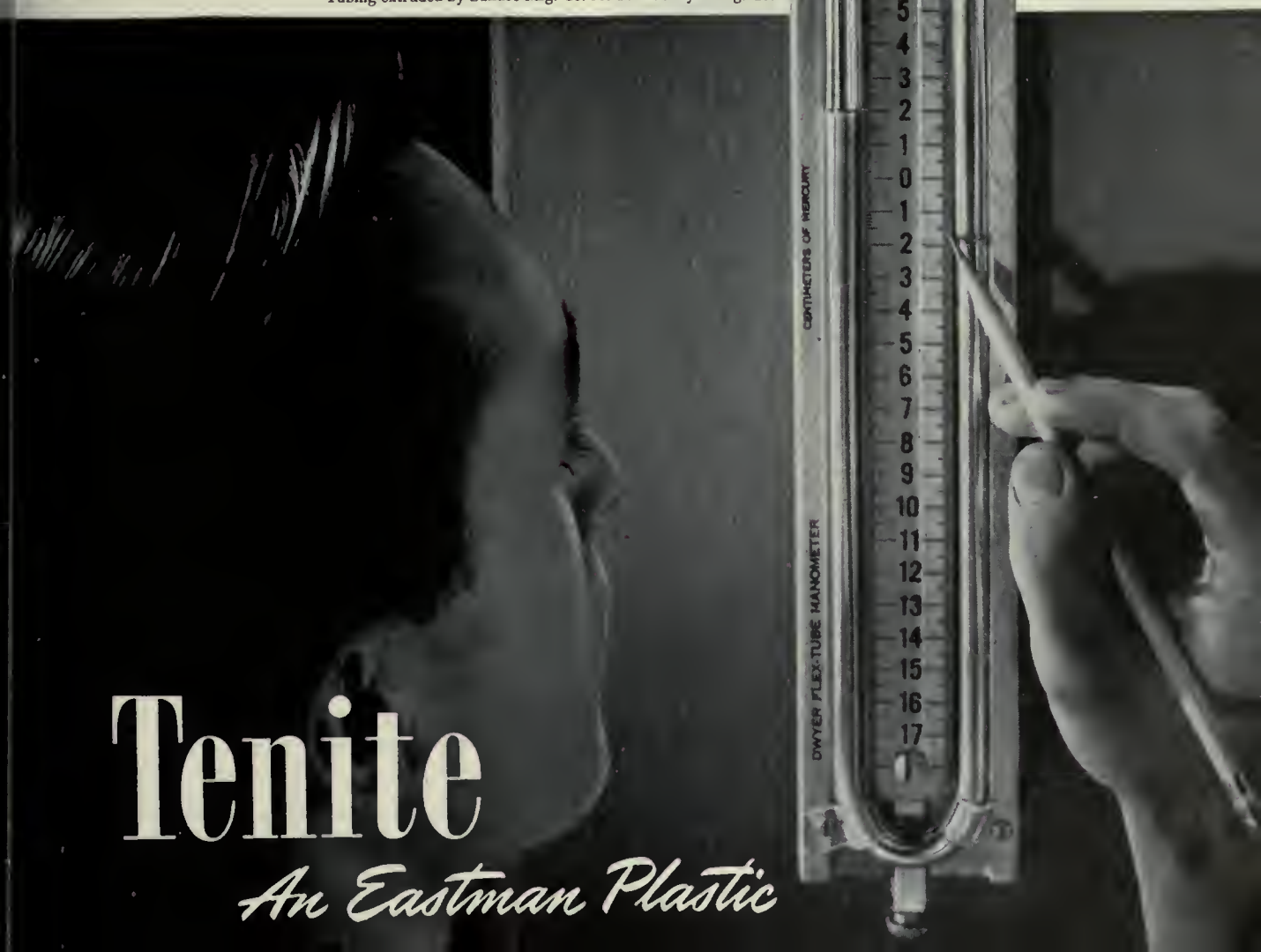
Produced by continuous extrusion, Tenite tubing is flexible and may be bent, formed, or curved to meet almost any condition. The ends of the tubing can be easily threaded and may be tapered to make leakproof press-in connections.

Tenite plastic tubing in continuous lengths is available in sizes up to and including two inches in diameter. It is widely used in the beverage-dispensing, commercial refrigeration, and aircraft industries. For further information about Tenite and its uses, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Co.), KINGSPORT, TENNESSEE.

TENITE REPRESENTATIVES

New York, 10 East 40th Street. *Buffalo*, 1508 Rand Building. *Chicago*, 1564 Builders' Building. *Dayton, Ohio*, 305 Third National Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Mass.*, 39 Main Street. *Washington, D. C.*, 1125 Earle Building. *Pacific Coast:* Wilson & Geo. Meyer & Company. *San Francisco*, 15th Floor. 333 Montgomery Street. *Los Angeles*, 402 Architects Building. *Seattle*, 1020 4th Avenue, South.

Tubing extruded by Sandee Mfg. Co. for F. W. Dwyer Mfg. Co.



Tenite

An Eastman Plastic

Colored Acrylic Windshield Increases Pilot's Visibility

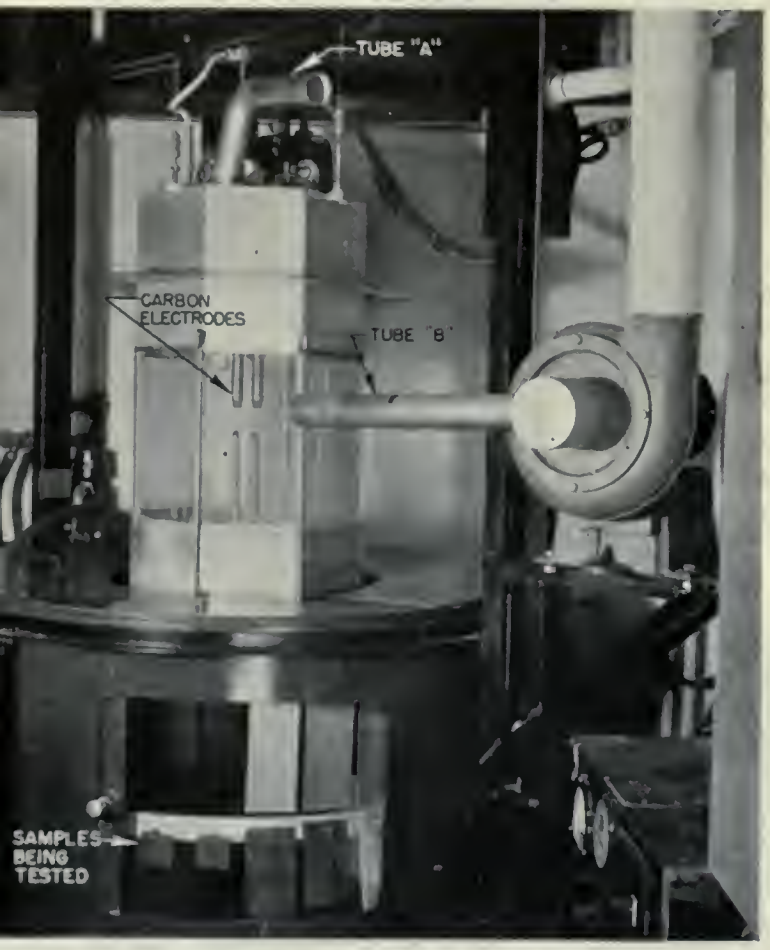


Fig. 1. (Above) The National Accelerated Weathering Unit

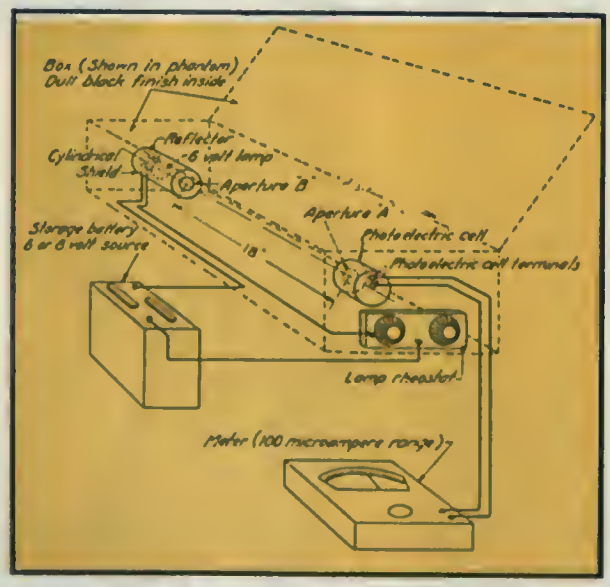


Fig. 2. (Below) Diagram of the Kline-Bowen Hazeometer

By Paul Silverstone
Engineering Research Dept.,
North American Aviation, Inc.

COLOR-FAST SURFACE DYED PANELS SHOW NO TENDENCY TO CRAZE UNDER EXPOSURE TO THE RAYS OF THE SUN

ONE cause of extreme pilot discomfort was the haze a glare created by the sun's rays on the transpare cockpit enclosure. One remedy was to provide the cr members with colored glasses and sometimes colored viso but these appliances not only reduced range of vision more often than not were more of a nuisance than a he

In order to solve the problem, North American Aviati engineers were called in. After some study, they advanc the idea of using an entire panel in the cockpit enclos as an anti-glare shield. The flight test department su gested coloring several enclosure panels, which was do by dip-dyeing them green, and then installing them on Mitchell B-25 bomber for test. At the same time, sm test panels were placed in a specially-developed accelerat weathering unit for check tests.

The colored panels immediately were endorsed by t test pilots who stated that they definitely increased visi and reduced sun glare, but faded slightly and also craz badly due to the effects of sunlight. The same defe were noted in the samples being tested in the laborator Because of these failures, an extensive series of laborato tests on new samples from a number of manufacture were instigated.

Through the efforts of the Krieger Color and Chemic Company of Los Angeles, there was developed a surfac dyed methyl methacrylate sheet which had extreme fa ness of color and did not craze when exposed to t effect of the accelerated weathering machine. Mo recently the du Pont Company also successfully dy methyl methacrylate sheet, which does not fade. In th case, however, the color is throughout the plastic. Aft considerable deliberation, it was decided that the prod tion part to be dyed would be the enclosure panel abo and slightly forward of the pilot. This would perm elimination of the sun visors mounted beneath this pan

After final engineering approval was obtained for t dip-dyed panels and the first production parts were bei installed, it was discovered that these panels still craz even while in stock. After some investigation, it was d

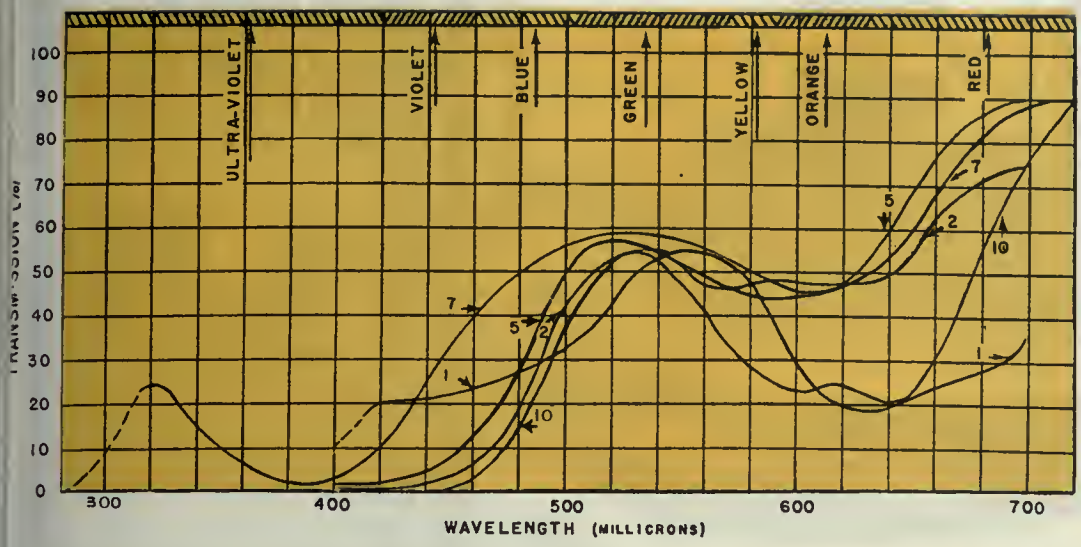


Fig. 3. Spectral transmission curves for Samples 1, 2, 5, 7, 10

ided that residual solvents used during the dyeing process were still present in the panels and if not completely removed, caused stresses to appear and thereby caused crazing. When the plastic was heat-cured at 300° F for several minutes, the crazing was eliminated.

Technical Discussion

Laboratory tests were run in the conventional manner, using standard equipment and methods of testing. The first and most important of these tests was to determine fading and crazing qualities of the colored plastic since too much fading and any crazing in service would materially decrease the value of the product. The obvious test would be to expose the colored specimen to the elements, but this would take too long for practical testing. Therefore, by the use of ultraviolet light, heat and water, an accelerated weathering system was devised for stepping up the action of the sun and the weather.

Fig. 1 is an inside view of the National Accelerated Weathering Unit, which was used. In the photograph, the center carbon electrodes have been lifted from the inside of the unit. When in operation, this center portion is dropped into the machine until Tube A meets Tube B and they are then connected. The samples are mounted on a circular ring which rotates about the center of the unit.

In the center are special daylight carbon electrodes which emit ultraviolet light. This light was not entirely satisfactory, so Corex D light filters were placed between the rotating test piece and the carbon electrodes. In addition, during rotation, water is sprayed on the part at one point of the cycle, amounting to about 18 minutes of spray time every 360° cycle. In this way, an accelerated weather condition is simulated. A period of 100 hours in this unit is equivalent to approximately a month and a half of exposure to conditions.

Another important requirement of the colored sheet is that it should have a certain degree of light transmission. That is, a certain percentage of the light reaching it must pass through. To measure this, an instrument called the Kline-Bowen Hazeometer was used as given in ASTM D672.

Fig. 2 is a diagrammatic sketch of the circuit. The test panel is placed in front of the photoelectric cell (aperture *A*) and, with the box closed, the light source, which is simply a 6-volt automobile electric light bulb, is flashed through the sample from the other end of the box (aperture *B*). The light passing through the colored sheet activates the photoelectric cell at aperture *A* and is measured by an ammeter. The sheet is then removed from the box and the same measurement is made without it. The ratio of the amount of light passing through the sample to the amount passing without it is the transmission value for the sample.

To evaluate the actual amount of each color in the tinted sheet, it is necessary to obtain the spectral transmission curve, which simply means that the amount of each color, i.e., red, green, etc., in the sheet is determined. This is measured in terms of wave lengths since, theoretically, each sensation of color is caused by a wave motion

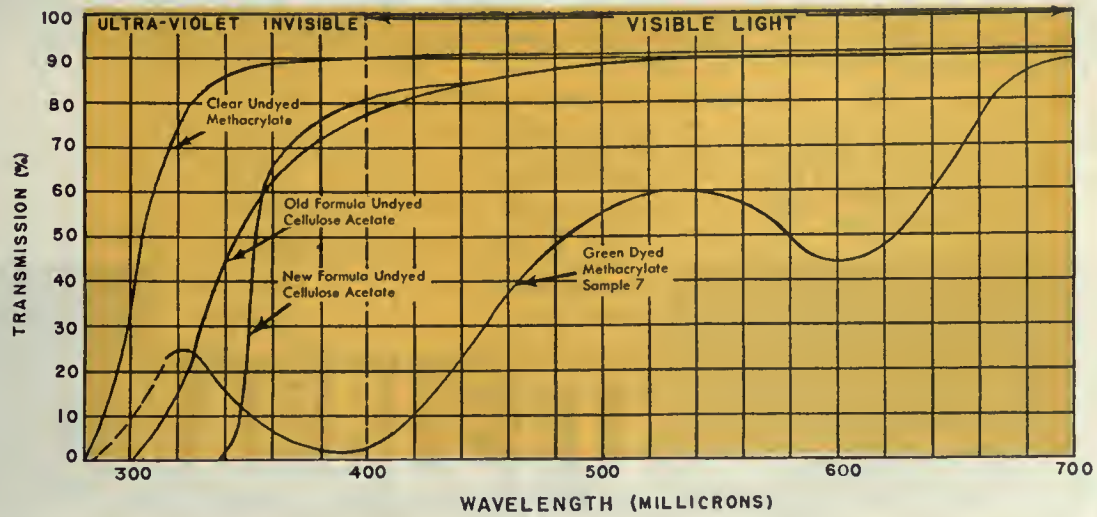


Fig. 4. Comparison of spectral transmissions of various transparent plastics sheets

Fig. 5. The softened colored sheet about to be formed by plaster dies

Fig. 6. Routing round slots in the she

having a definite length. The instrument used is called a spectrophotometer, which breaks up any combination of wave lengths into their respective categories. The values obtained are then plotted as shown in Fig. 3.

Haze is another important property of transparent plastics. This is a measure of the amount of light scattering caused by internal particles, surface scratches and other imperfections. It was measured by the Kline-Bowen Hazeometer in the same manner used for measuring light transmission, except that in addition to a reading taken in front of aperture *A*, a reading is also taken in front of aperture *B*, and the percent haze is equal to

$$\frac{T_A - T_B}{T_A} \times 100$$

where:

T_A = reading of ammeter obtained with specimen at aperture *A*.

T_B = reading of ammeter obtained with specimen at aperture *B*.

The more light scattering the specimen has, the greater is the glare.

Results of Tests

The results of tests made after exposure in the accelerated weathering machine are shown in Table I.

Data obtained in Table I is extremely valuable, since it tells whether a colored sample will be resistant to weather, from the standpoint of light transmission and haze. For example, see Sample 6. The transmission before weathering is 36%, while after weathering 100 hours, it has increased to 70%. This means that it has faded materially.

On the other hand, Sample 7 had 55% transmission at the start and faded only to 57.8% at 500 hours exposure, which means that the dye used is extremely stable to sunlight exposure. As is noted, this sample seems to have a material increase in haze value going from 6.8 at the start to 26 at 500 hours. This, of course, is not desirable and should be held to a minimum.

Undyed methyl methacrylate has haze values ranging from 0.2 to 2%. In most cases, the dyed sheet before aging has values above the undyed sheet, which indicates that dyeing has increased the extent of haze. This increase apparently is due to the fact that the dye particles are not sufficiently dispersed in the plastic. However, the effect of this is not apparent to the eye in the colored panels tested and therefore is not considered of major importance. On the other hand, haze in the atmosphere is caused by the scattered light of short wave lengths. The fewer of these present, the more distinctly the objects appear.

A comparison of the curves in Fig. 4 shows that the green colored specimen (Sample No. 7, Table I) allows less of the shorter wave lengths to pass than does the

(*Continued on page* 100)

TABLE I:—Weather Exposure Data

Sample No.	Weathering Accelerated (Hours)	Time Normal (Months)	Approximate Transmission (%)	Approximate Haze (%)
1	0	0	—	—
	100	1½	41	—
	200	3	43	12.6
2	0	0	51	—
	100	1½	54	5.1
	200	3	55	5.8
3	0	0	49	—
	100	1½	50	0.6
	200	3	52	6.1
4	0	0	47	—
	100	1½	49	0.8
	200	3	51	3.9
5	0	0	50	—
	100	1½	53	4.5
6	0	0	36	—
	100	1½	70	20.0
7	0	0	55	6.8
	100	1½	—	—
	400	6	56	—
	500	7	57+	26.0
8	0	0	—	—
	400	6	10	3.8
	500	7½	11	3.6
9	0	0	—	—
	400	6	28	23.6
	500	7½	30	6.7
10	0	0	32	—
	100	1½	35	0.0

The spectral transmission curves for the various materials tested in Table I are shown in Fig. 3.

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To Finished Casting....

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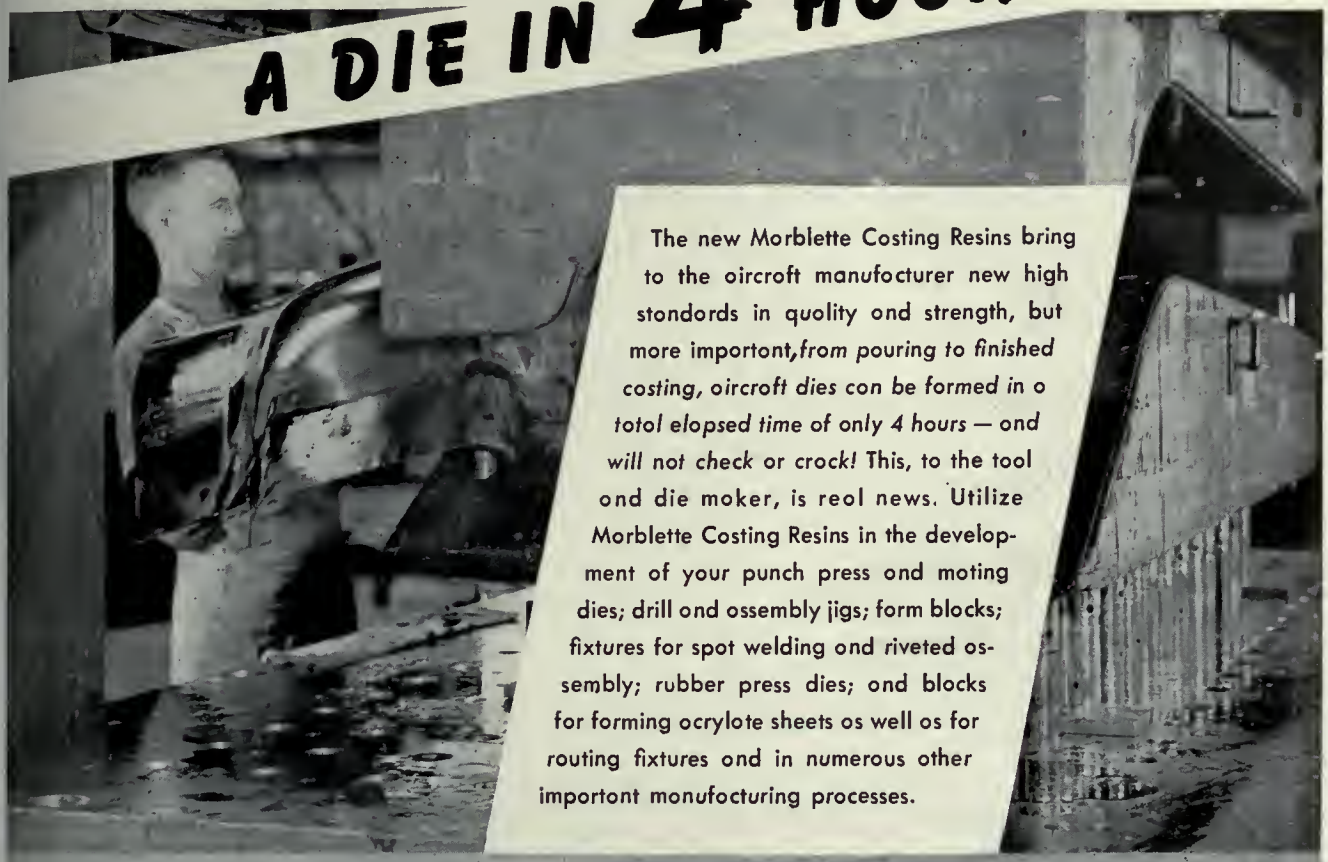

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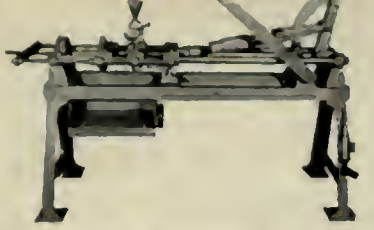
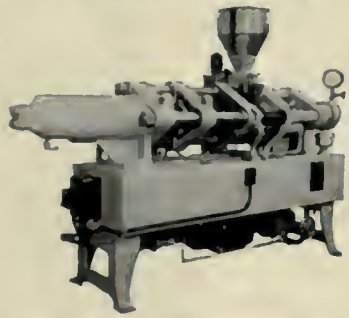
New H-P-M

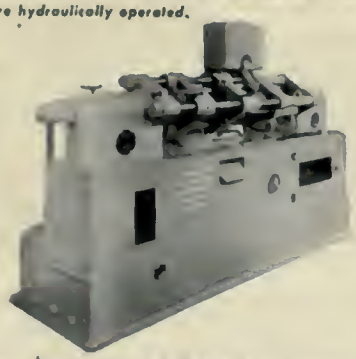


The first "American made" injection molding machine for the plastics industry . . H-P-M built it in 1931. This machine was manually operated.

In 1934, H-P-M built the first injection molding machine incorporating an oil-hydraulic injection unit. The mold was manually clamped by a bayonet type lock.



In 1935, H-P-M built the first "oil-hydraulic" injection molding machine. Both injection and mold clamp actions were hydraulically operated.



Many improvements, including greater production capacity, were incorporated in this "streamlined" H-P-M injection molding machine built in 1937

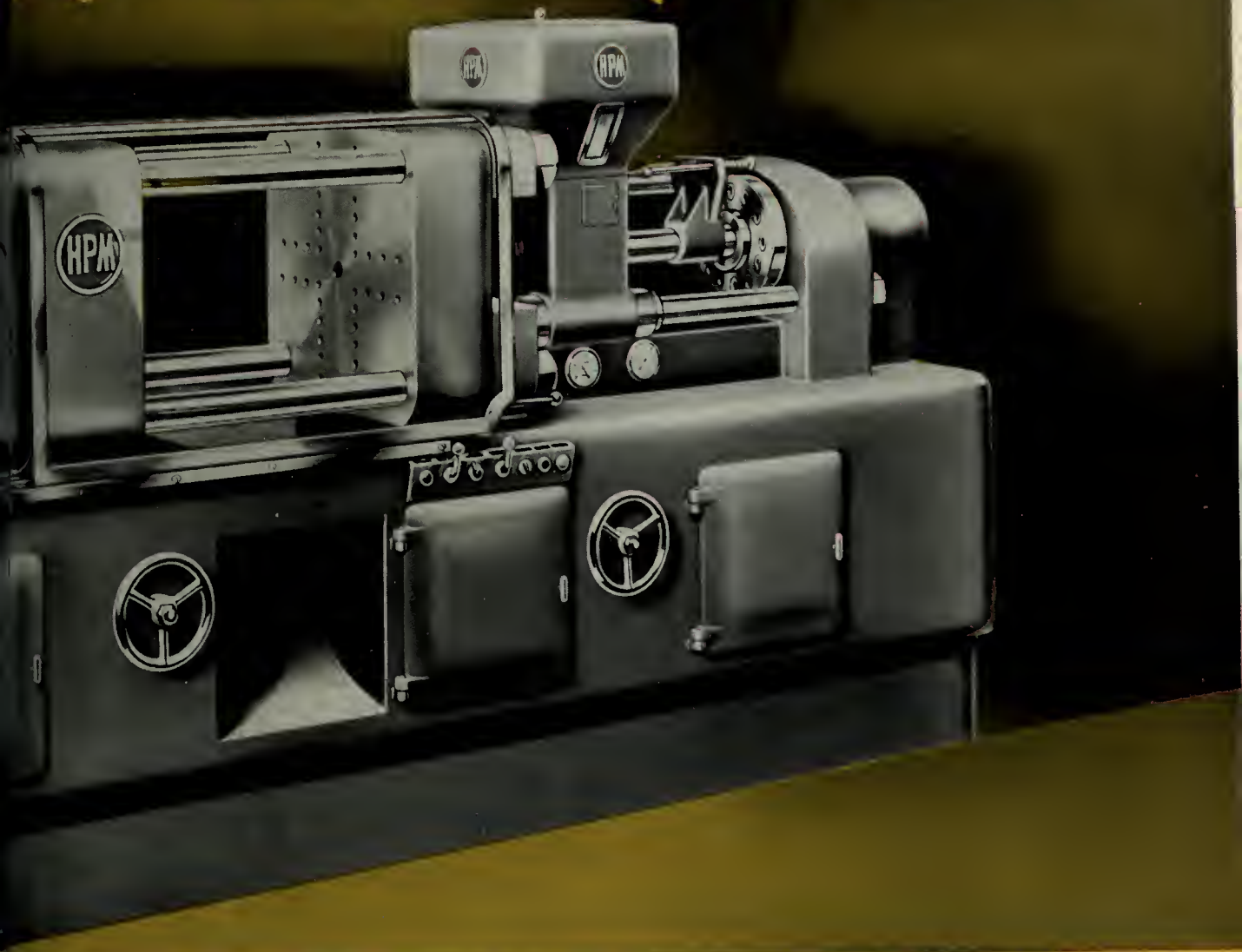
More improvements, including four rod guiding of clamp platen, were incorporated in this H-P-M injection molding machine. Recently equipped with a new material heating chamber with electric band heaters this machine is being currently offered in both four and nine ounce capacities.

H-P-M's thirteen years of experience in designing and building plastics injection molding machines are represented in this new sixteen ounce capacity machine. A self-contained unit, with "oil-hydraulic" operation, the 350-H-16 will answer the ever increasing need for larger capacity machines for production molding of thermo-plastic parts.

Professionally styled, the H-P-M 350-H-16 will enhance the appearance of any molding plant. Its simplicity of operation and control are outstanding. The H-P-M straight line hydraulic mold clamp provides positive sealing of mold, rapid die change-over, automatic slow-down and many other features.

EXPERIENCE ARE REPRESENTED IN THIS

Injection Molding Machine



The newly designed material heating chamber, equipped with electric band heaters, guarantees ample plasticizing capacity with accurate zone heat control. New gravity type material feed is simple and positive.

H-P-M injection molding machines are powered by the reliable H-P-M oil-hydraulic operating system. Each pump, valve and control is designed and built by H-P-M, especially for heavy duty molding service. This unity of origin and manufacture of both operating equipment and machine not only assure coordinated functioning, but also undivided responsibility to the user. Write for Bulletin 4405 describing this 16 ounce H-P-M injection machine.

HPM

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It may seem strange to think of glass adding great impact strength to any material. Yet that is just what happens when Fiberglas*—in the form of woven glass fibers—is used to reinforce certain plastics.

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Besides its surprising ability to absorb shock, this new Fiberglas-plastic material combines great strength (in tension and compression) with very low weight. It also has dimensional stability (neither shrinks nor stretches) and has high fatigue resistance under vibration and other stresses.

All these features have combined to provide outstanding advantages for many special applications on military aircraft.

Another real value of this glass-reinforced plastic is the ease with

which it is fabricated into complex shapes and forms. Expensive dies and great pressure aren't needed. Machining is quick, accurate and clean.

Admittedly, there is much to learn about this new material. Some authorities have called it a new material of construction. The ingenuity of engineers and designers of the plastics industry will broaden its use.

Manufacturers and design engineers desiring more information regarding this revolutionary development or the reinforcing Fiberglas Textile materials, now available in quantity, are invited to write: *Owens-Corning Fiberglas Corporation, 1881 Nicholas Building, Toledo 1, Ohio; in Canada, Fiberglas Canada, Ltd., Oshawa, Ont.*

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This modern version of an Indian warrior's birch-bark is an army standby doing service in arctic and tropical waters

Boat Hulls Molded From Wood and Resin

By James J. Dunne

Vice President,
United States Plywood Corporation

Army Utility Power Craft Is Largest One-Piece Plywood Molded Article

EARLY in 1939 in the little town of Algoma, Wis., a huge 8 by 35 ft autoclave was opened and a group of hopeful enthusiasts peeled a rubber blanket from an 8 ft dinghy form to inspect the first attempt to mold plywood boat hulls commercially. Every laboratory trial had predicted success but when the hull was cool enough to examine, these pioneers found their first attempt a complete failure. The rubber bag had leaked, pressure had been inadequate and the resin adhesive had failed to cure.

Today from this same autoclave and others like it come perfectly molded hulls for the Army Engineer Corps' renowned utility power boat, such as the one illustrated here, which is on display at the current exhibition of the Museum of Modern Art, New York City. These perfect examples of the plywood molding technique are 18 ft long, have a 6'6" beam and weigh 245 lbs. These hulls are the largest and heaviest plywood articles ever molded in one piece.

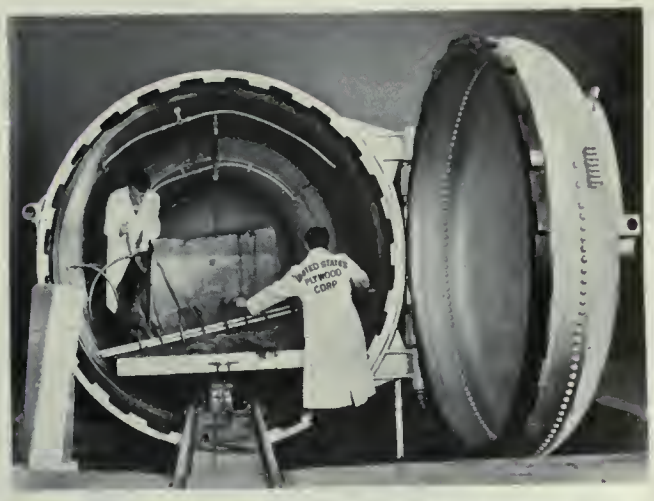
To perfect the plywood molding technique, engineers and chemists of the United States Plywood Corporation followed their first failures by continuing to experiment with full-size hulls. After developing the 8 ft dinghy, units of 12 ft were produced and when war started hulls of 15 ft were in production. By this time 1200 small boats had been put in service and when the Army Engineers designed the utility power boat the process was so reliable that the first Army hull attempted was a perfect molding.

The Army hull is 7-ply $\frac{7}{16}$" thick with a molded in laminated oak stem. The five center plies are of soft wood, and the faces are birch. Each ply is cut $\frac{1}{16}$" thick.

After inspection, veneers are templated to shape and size and coated with a special formula of phenol formaldehyde resin which is a Durez base. The adhesive has the peculiar property of rendering the veneers exceptionally pliable so that they will adapt themselves readily to the peculiar tunnel-shaped bottom of the hull. Resins which make veneers brittle generally contribute to the friction which prevents the slippage necessary if the veneers are to seat firmly against the mandrel or boat form.

Coated veneers are force dried and may be stored for weeks before being laid up on the mandrel. The resin is spread at the rate of from 30 to 35 lbs per thousand sq ft of single surface. In addition to being coated with bonding resin the outer layer of birch veneer is saturated with

(*Continued on page 97*)



Boat molders are steadily gaining experience in autoclave technique in preparation for other giant plywood moldings

Plastics Treatment Gives Wood New Characteristics

By Dr. J. F. T. Berliner

Ammonia Department
E. I. du Pont de Nemours & Co.

A PLASTIC treatment of wood which is likely to make it a formidable competitor of plastics themselves has been developed at our laboratories far enough to warrant this full-length report on it. For it has already emerged from the laboratory stage as a practical possibility, superior to the many materials and processes previously tried out to minimize the swelling, shrinking and warping of wood and to improve its hardness and strength—superior to treatment by resins, partial resins, resin-forming chemicals and a host of others, including salts, sugars and various gases.

Equipment is being installed by a number of companies for the industrial utilization of our process.

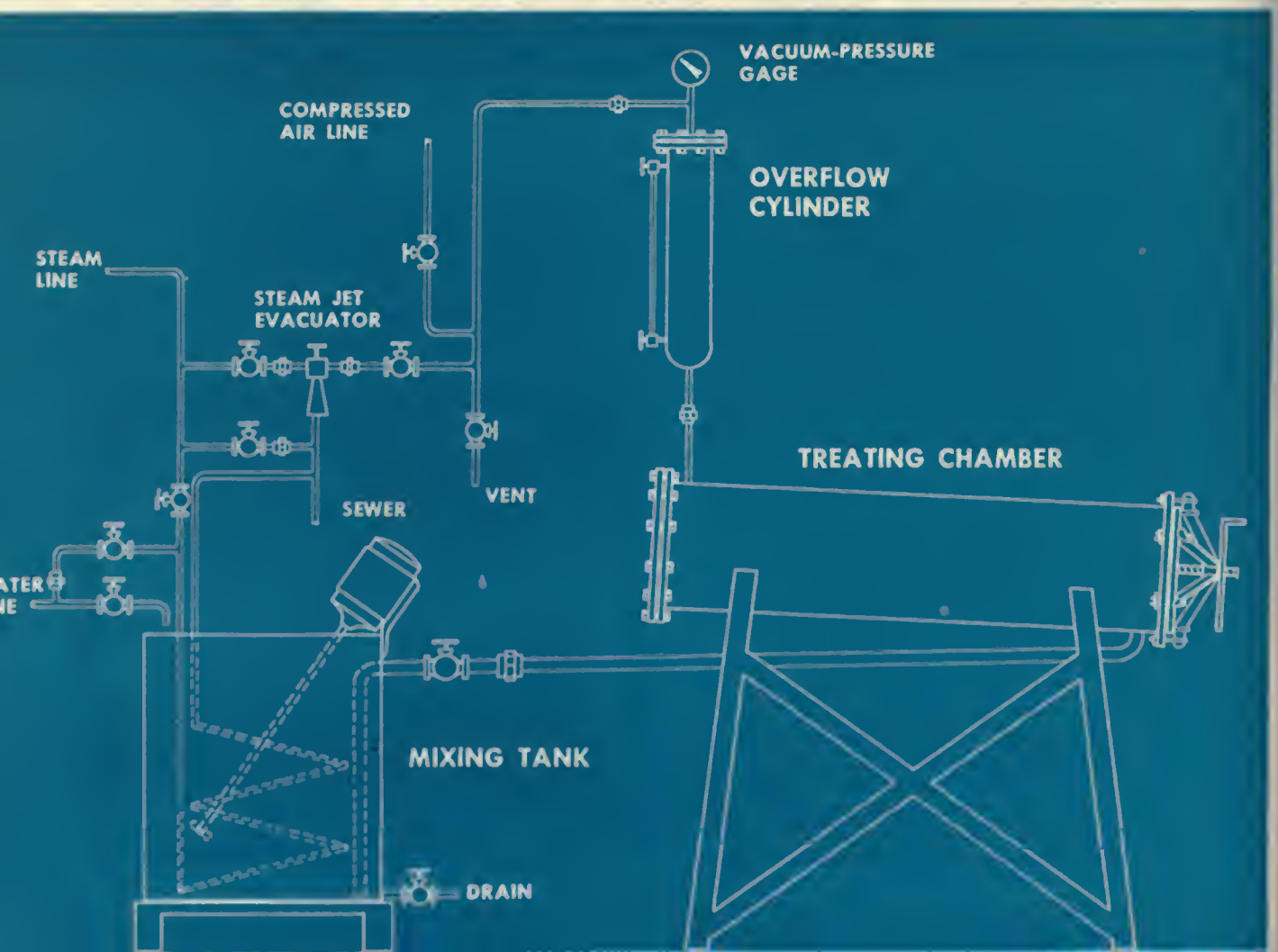
The process calls for the impregnation of wood by methylolurea—a treatment which imparts properties to it which it does not naturally possess, which in fact transmutes wood into something quite different from wood though it continues to look like it.

The lumberman carefully distinguishes between the different species and grades of wood, but he tends to think of a board in the dealer's yard as his finished product. The chemist looks on wood as a raw material, the properties of which may be altered to overcome its natural limitations. To him wood is primarily cellulose and lignin, and the varieties differ mainly in how these two substances are distributed and arranged; in other words, species differ structurally but are, chemically, quite similar. Methylolurea, which reacts with itself under certain conditions to form hard, water-insoluble, infusible resins, also can react with the components of wood to alter its properties profoundly.

When sufficiently treated, the wood loses its natural tendency to swell or shrink or warp with humidity changes, nor will the grain rise on wetting. The wood becomes markedly harder, stronger, stiffer and more durable. It can be highly polished and more smoothly worked. Its tendency to shred and splinter during sawing, planing, cutting and turning is reduced.

The natural color of wood is not altered by the treat-

Equipment used at du Pont experimental shop in impregnating wood with methylolurea by vacuum-pressure



Methylolurea Found as Agent for Impregnating All Kinds of Wood with a Tough Resin to Transform Them to Almost Metallic Strength, Hardness

ment. Moreover, suitable dyes may be introduced with the treating chemicals to color the wood throughout. For instance, a light colored pine or poplar can be given the color of cherry, rosewood or mahogany, or even a brilliant red, green or purple, non-existent in natural wood. Freshly exposed surfaces may be finished without staining or matching, and scratched or marred surfaces may be easily restored by rubbing.

Within the limits of possible impregnation, one species may be substituted for another or used for purposes for which it was not previously suitable. Thus, more available or lower cost woods, or woods having more favorable color or grain characteristics may be utilized. Wood may be endowed with the properties required and one need not be limited by its natural characteristics. For instance, poplar and soft maple can be made harder than hard maple, while hard maple can be made harder than ebony.

Wide Applications

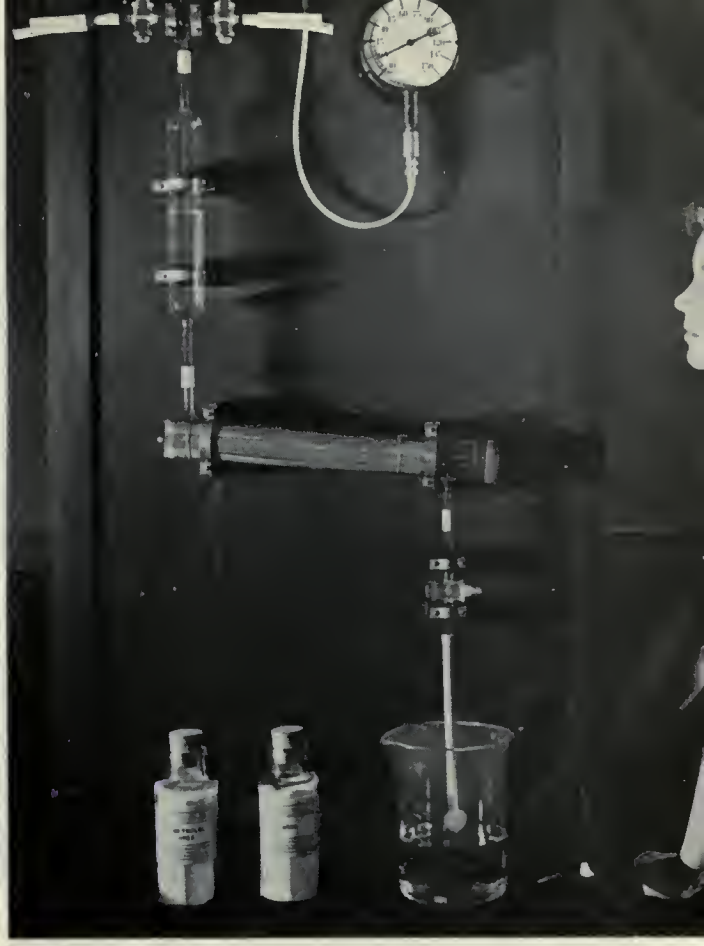
Thus, treated soft woods can release more expensive or desirable woods for other essential uses. Soft maple or other close-grained woods may be used to replace dogwood or persimmon in textile shuttles. The compressive strength of wood as well as its hardness and resistance to the effects of moisture can be so increased that treated wood may be substituted for steel in certain textile machinery parts where wood has hitherto been unusable.

The methylolurea process appears at this time to be applicable to almost all items manufactured from wood, from utility poles and structural timbers to pipe stems and parts for musical instruments. Fabricated articles such as veneers, flooring, furniture, boats, textile and other machinery parts, sports goods, pulleys, tool and knife handles, millwork, screen and door sash, rollers, wood heels, pencils, shoe lasts, tanks, sanitary ware, laundry equipment, chemical equipment, agricultural implement parts and many other items would be improved by the use of treated wood.

The Process

The impregnation of wood with resin-forming methylolurea and the conversion of this chemical to resin within the wood is relatively simple and inexpensive, involving no new procedures or new or special equipment. Methylolurea is a term designating the series of compounds formed when urea and dimethylolurea (DMU) are used. DMU—$CO(NHCH_2OH)_2$—is the primary condensation product of two mols of formaldehyde and one mol of urea.)

A water solution of an uncondensed methylolurea is forced into the wood structure. The methylolurea is then converted to resin by the natural acids present in the wood. Heat, such as in normal kiln drying, speeds the conversion of the methylolurea in the wood to water insoluble resins. However, this process takes place with sufficient rapidity at normal temperatures to be completed in the usual air drying period.



On top the lab table the vacuum-pressure system works in miniature on pieces of wood in the horizontal glass tube

A permanent resin that is both hard and insoluble is developed within the wood structure either at normal or at kiln temperatures. If the kiln drying has not been at too high a temperature or if conducted rapidly enough, the resinification reaction will proceed to the insoluble but still fusible stage and will remain so for a period of time. If wood so dried is heated to 240° F or higher, the resin fuses and will flow under pressure and the resinification is rapidly completed to the infusible state. The wood will permanently retain the dimension and surface produced by the compression.

In this way, a stable, extremely hard, dense product is obtained with a consolidated closed surface requiring no filling, sanding or polishing. With moderate pressures, only the surface of the treated wood may be converted to a finished, hard surface. If polished or embossed platens are used, these finishes are reproduced in the surface of the wood.

The solution may be impregnated into wood by various means. Perhaps the most effective is the so-called "full cell" or vacuum-pressure impregnation process. The wood is placed in a chamber and the air withdrawn. The treating solution is then introduced into the evacuated impregnating chamber in sufficient quantity to cover the wood and allow for the volume of solution which will be absorbed. The chamber is then opened to the atmosphere, or air pressure applied. After a determined period the solution is drained off and the wood removed for drying. For small items, centrifugal impregnation may warrant consideration.

For most purposes, the wood should be dry or at least dried well below its fiber-saturation point. When the methylolurea solution is forced into the wood, it first enters

Dipped in acid, treated wood is unaffected, raw wood chars

the cell cavities. Then it rapidly diffuses into the cell walls, where, under the influence of the acids of the wood, it promptly begins to polymerize into an insoluble resin. If wood is green, the cell cavities are partly full of "free" water and the fibers are saturated. This impedes the rate of diffusion of the methylolurea into the cell walls, and it may convert to the insoluble form before it has an opportunity to soak into them.

Proportions of Chemicals

The uncondensed methylolurea may be obtained by reacting urea and formaldehyde in the proper proportions under controlled conditions. However, a simpler, more economical and convenient method of preparing the solution is merely to dissolve urea and DMU in water in the required proportions. DMU is a condensation product of formaldehyde and urea.

The proportions required will depend somewhat on the nature of the item being treated and the results desired. For most purposes a solution of 1 to 2 parts of urea and 6 parts of DMU dissolved in 20 to 24 parts of water is satisfactory.

A solution of one part urea to 3 parts of DMU is prepared by dissolving 30 pounds of urea and 100 pounds of commercial DMU (equivalent to 90 pounds of dry DMU) in 350 pounds or 42 gallons of water. This will result in 53 gallons of solution. The solution should be prepared in a tank equipped with a steam coil and a stirrer to effect rapid solution. The solids are added and the solution heated to 130 to 150°F during its preparation.

Since methylolurea solutions are highly reactive, certain precautions are necessary to prolong their usefulness and prevent spoilage. If the solution is to be stored for more than eight hours, it must be kept cool and mildly alkaline, at a pH of about 8.0. When freshly prepared from urea and commercial DMU, the solution will have approximately the desired alkalinity. When wood is impregnated with this solution, wood acids are extracted and the solution tends to become acidic. In operation, the solution may be allowed to become slightly acid (pH not less than 6.0) if promptly neutralized with alkali, avoiding an excess (pH not above 9.0). The acidity of the solution can be readily controlled by the use of special test papers.

If the wood is to be colored by the treatment, water soluble dyestuffs are added to the treating solution. The color produced by the dye is apparently not affected by the methylolurea. The dyes selected should have a neutral or slightly alkaline reaction in solution.

Both urea and DMU are commercially available and inexpensive chemicals, now being produced on a large scale. Both materials are under allocation by the War Production Board. However, in the small quantities required for investigation and preliminary tests they are available without formal allocation.

The concentration of the methylolurea in the solution, the particular methylolurea used (that is, the proportion of urea to dimethylolurea), the temperature, what pressure, if any, is applied, and the length of each phase of the treating cycle, are conditions that depend on the nature of the item being treated, its dimension and species, whether of sapwood or heartwood, what degree of treatment is necessary, and what final properties are required.

For most veneers, up to $\frac{1}{8}$", it is not usually necessary to apply pressures above atmospheric to obtain adequate absorption. For deep penetration of lumber, pressures of 50 to 100 pounds or more per square inch are required. For sapwood of both softwoods and hardwoods and the heartwoods of some hardwoods, an impregnation cycle of 20 to 50 minutes vacuum (26" or more), followed by 100 pounds per square inch pressure applied for 10 to 50 minutes at room temperatures, is usually sufficient.

To conserve chemicals, increase the capacity of the treating unit, and reduce impregnation time, it is preferable that the wood article be cut to almost its final form prior to treatment. The items to be treated need not be separated nor spaced but may be bulk-piled in the treating chamber or loaded in bundles, even in baskets. Allowance should be made for the expansion of the wood during the heating.

The Equipment

The equipment required may be quite simple. It can be of the same type as now used in treating lumber with creosote and flameproofing chemicals, though because of shorter treating cycles, smaller scale equipment may be used. A steam jet ejector is an effective means of producing the vacuum. The treating chamber should be equipped with a pressure door or removable head and a source of vacuum and of pressure. Mild steel equipment may be used. The chemicals are no more corrosive than water and are neither flammable nor toxic. To prevent rusting and possible discoloration of the wood, it is desirable to apply a waterproof finish to the exposed surfaces of the equipment.

Methylolurea treated wood differs from untreated wood somewhat as steel differs from iron. Treated wood may require slower rates of sawing, cutting and turning, different tool settings, harder tools, or more frequent sharpening of tools, than untreated wood. Because of its increased hardness and density, more power is required to drill holes and insert screws. However, the screw-holding strength is higher than for untreated wood. Likewise, it is more difficult to drive nails into treated wood but the nail-holding ability appears to be improved.

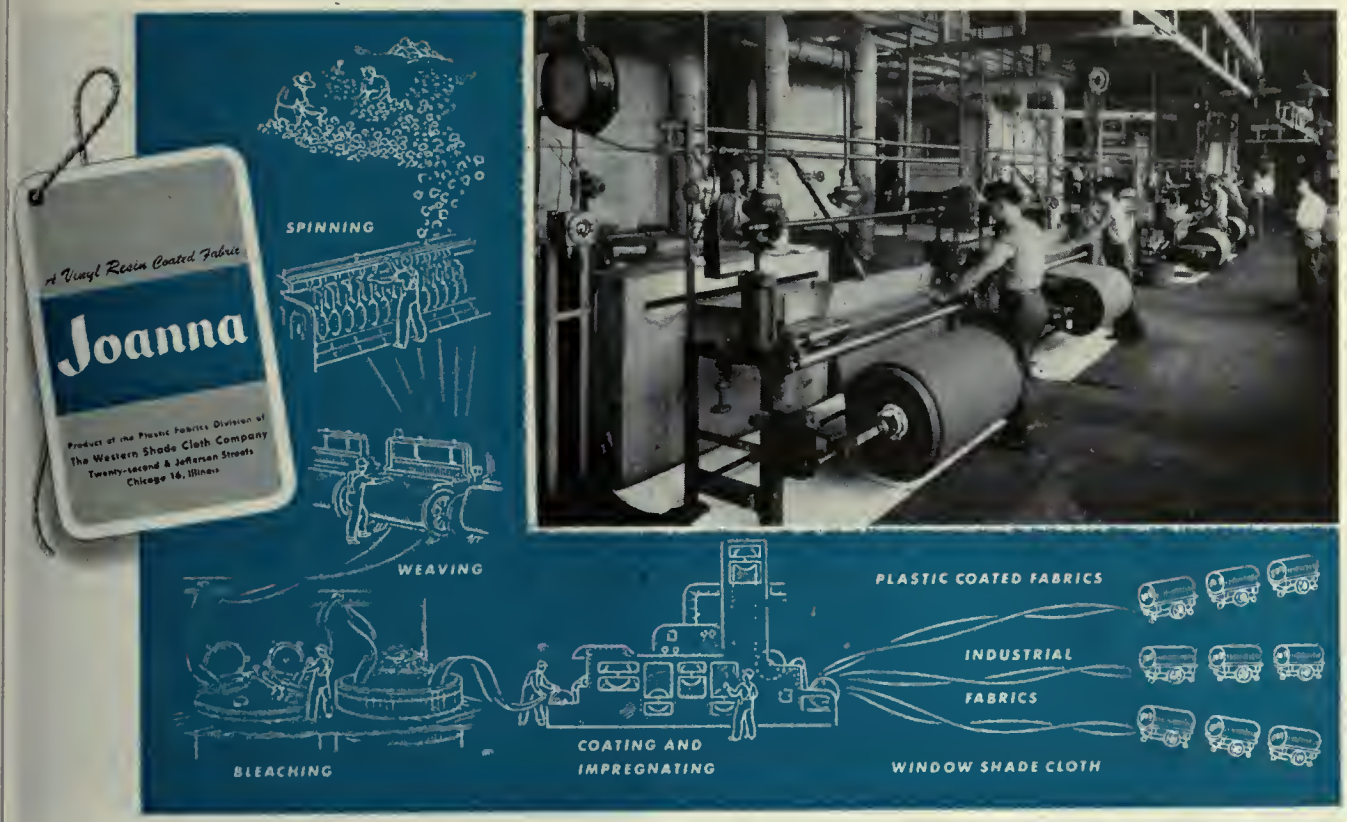
Self-bonding Plywoods

Treated veneers have increased strength and stiffness and may be used to form dimensionally stable plywoods that will resist checking, warping and splitting. Finished, highly polished, hard, mar-resistant surfaces may be produced directly by compressing the treated veneers under heated, polished platens.

When veneers are sufficiently impregnated and dried, they become self-bonding under high heat and pressure and no other adhesive is required to form plywoods. The heat fuses the resin formed in the wood, resulting in a hard, dense product.

As far as is now known, the treatment does not have

(*Continued on page 90*)



PLASTIC COATED FABRICS may play an important part in your plans for the future

When industry again turns to peace time pursuits there will be a heavy demand for many kinds of fabrics "*multi-proofed*" *with plastics.*

Vinyl resin coatings are here to stay. Called upon, after Pearl Harbor, to pinch-hit for scarce, conventional fabric proofing materials, they have performed superbly under most difficult conditions. For hundreds of applications they have permanently replaced the protective materials for which they were substituted.

Coating fabrics with plastics is nothing new to our organization. Long before Pearl Harbor, it was an accomplished fact. With a background of nearly half a century of fabric coating experience we were among the first to master the difficult technique of applying plastic coatings to cottons, silks, rayons, nylons, ducks, burlaps and paper.

Chances are that somewhere in your post-war operations you will use to good advantage some type of fabric coated or impregnated with protective plastics.

You, for instance, may be a manufacturer of items for consumer sale such as luggage, furniture, books, rain wear, shoes, shower curtains, garment bags, baby carriages, mattresses — or —you may be a manufacturer of heavy goods such as railway coaches, airplanes, automobiles, trucks, refrigerators, etc. If yours is a fabric problem, we believe we can supply the answer.

Our research and manufacturing facilities are now devoted largely to the production of fabrics for our armed forces and essential civilian uses. When production can be safely diverted from these essential requirements, our entire facilities will again be at your service.

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Plastic Fabrics Division: VINYL RESIN, PYROXYLIN AND OTHER PLASTIC COATINGS • PROOFED FABRICS AND PAPERS • SIMULATED LEATHERS
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JOANNA TEXTILE MILLS, GOLDVILLE, SOUTH CAROLINA

This molded microphone housing seems to be quite satisfactory in ordinary white light

But under black light, after treatment by fluorescent method, it shows flaws aplenty

Black Light Inspection Of Molded Parts

Cracks Show Up in Fluorescent Glow in Near-ultraviolet Light

By Franklin S. Catlin, Jr.
Magnaflux Corporation

AS plastics molded parts find greater functional uses in mechanical installations, both now and in the post-war era, it becomes increasingly important that they be free from production and handling imperfections which reduce their usefulness as load or stress carriers. It is advisable and necessary therefore to inspect such parts for evidence of incipient cracks or surface flaws conducive to fatigue failure, one of the causes of a part's break down in service.

It is inevitable that plastics parts will play a more important role in post-war industrial equipment; the war has made all this possible by expanding the uses of plastics many years beyond where they would have been if we had remained at peace. Yet, as with wartime service, peacetime applications also will require complete reliability of molded plastics parts free from defects to assure consideration of plastics based on fundamental good qualities rather than on the failure that may occur to a few individual pieces.

As a means to this end, better inspection will improve the value of plastics in load-carrying application. Conventional visual inspection reveals only surface cracks which mar appearance but it falls short of meeting the exacting requirements for thorough inspection of stress carrying parts.

An unusual technique is now being applied as an inspection process for detecting flaws in industrial plastics parts. It is a fluorescent penetrant method known as the Zyglo (a patent license) process, already in wide usage in the metals inspection field.

Inspection As the Preventive

The axiom that a chain is no stronger than its weakest link is never better exemplified than when tension stress is concentrated on certain working parts of a mechanical unit. Service failure resulting from defects in such parts has continued to be one of the principal concerns of designers, producers and engineers. The preventive solution is to reject parts through revealing minute fissures before the parts go into service, for even an insignificant crack may generally develop into a major fracture and finally cause failure of the entire installation.

Fundamentally, a crack, small or large, crossing a stress field localizes the stress at its ends. There the

Parts are dipped in liquid which penetrates cracks not visible to naked eye; inspection then reveals flaws

effective amount of stress is considerably higher than the average of the stress field, the increase being as high as 10 times. Furthermore, the concentration of stress is more a factor of the ratio of width to length and depth to width (that is fineness of the crack) than a factor of its absolute size. For these reasons a working part with an average tension stress level of 1000 psi (which is high but reasonable), would have an effective stress of 10,000 psi at a small, invisible crack. The latter figure is extremely high, and the average molded plastics part cannot withstand it for long, particularly when the service load is repeatedly applied and released in the operation.

Good plastics design takes fatigue failure of materials into account by eliminating, wherever possible, acute corners and abrupt thickness reductions and other stress raisers. Wall thickness and shapes are designed to evenly distribute the stresses over the entire piece; thickness reductions are bevelled and corners filleted. But inspection for the stress raiser, even though it may be minute, is a necessity, as any complicated part will have areas of relatively high stress.

Cracks may also cause service failure of types other than fatigue. For instance, a radio insulator should be crack-free because the electrical characteristics along the crack will be lower than those of uncracked material. Water or other foreign matter may accumulate in such cracks during use, disturbing the electrical characteristics intended for the plastics part, making it conductive. Freezing of water inside cracks of some parts in service may expand and further crack the piece.

The Invisible Becomes Visible

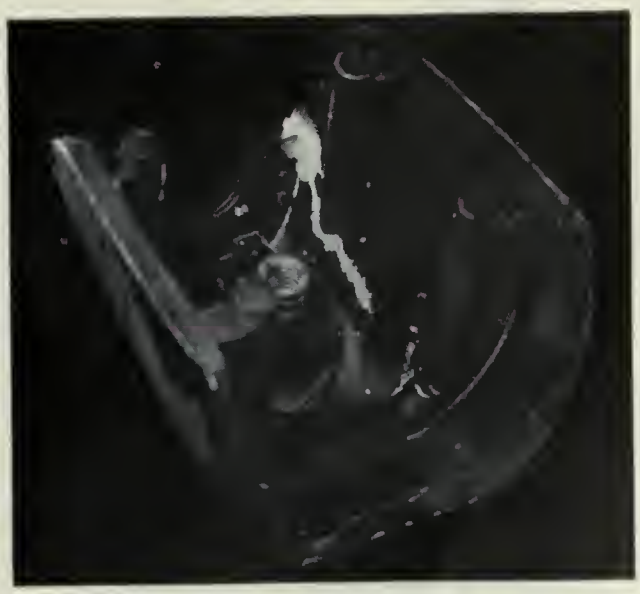
Any inspection method used to locate defects in manufactured parts must be sufficiently sensitive to locate all cracks and other flaws. It should be reliable in a wide range of parts and types of defects, and be rapidly applied to large numbers of parts. It should be useable as early in manufacture as possible—before extensive handling, machining or assembly has been wasted on defective parts.

In using the fluorescent penetrant inspection method, parts are rapidly processed by the basketful and may be inspected quickly without extensive time-consuming searching on the inspector's part. Molded plastic parts can be inspected after curing and cooling. If desired, the parts can be inspected after machining and handling to assure final freedom from defects at the time of assembly.

The fluorescent penetrant method depends upon the penetration of a fluorescent liquid into any defects open to the surface. Zyglo penetrant is an oil base material with unusual penetrating ability, high fluorescence and water washability. In production inspection, parts by the basketful are dipped into a tank of penetrant and placed upon racks to drain. Drain time allows the penetrant film

(*Continued on page* 102)

Another example of a part, a molded plastics bracket, which visual inspection would okay



And again the fluorescent penetrant method illuminates serious defect in the bracket

Shoes LOOK TO PLASTICS

These husky mountain-troop soles are planned in a synthetic rubber and polyvinyl chloride compound by Goodyear for the post-war hiker

THE shoe industry definitely looks to plastics for many post-war developments, and the plastics industry reciprocates the interest. But on both sides there is a healthy trend to caution and a desire to await the results of much research pointed to top-notch performance qualities once civilian production is resumed.

It is felt that too many claims were made for plastics shoes when they were introduced several years ago. True enough, the translucence and other decorative values of these early shoes aroused considerable interest among women buyers, but much work was still to be done to establish wearing qualities. Now with the wartime imposed hiatus on civilian production, research has its chance to assure an important and sound place for plastics footwear in the post-war period.

As a wartime replacement for scarce leather, canvas soles impregnated with synthetic resins have found a spot as one wartime civilian use of plastics in shoes. Plastics materials available for this purpose have obviously been limited by wartime restrictions, and results, therefore, have not been as uniformly satisfactory as desired. But there are new formulations being developed at present which offer a bright future in this direction. Typical is a compound of polyvinyl chloride and synthetic rubber which is now being perfected for post-war use.

B. F. Goodrich show their plastic used for soles in rationed shoes that have leather uppers and are for street or more formal wear

Wide range of color is the feature of these unrationed shoes, manufactured by the Tobo Shoe Co. Canvas soles are impregnated with plastics materials

Color...Design...Originality

...are vivid aids in the merchandising of many cosmetics and toiletry products. Here, the inherent properties of plastics fulfill these basic consumer demands. *(See article on Page 48)*

Before the decorative rivets are driven they are heated to soften them for applying the compressed air swelling and clinching method

Great variety of color, size and design can be achieved in these plain and plated rivets. Here a LUCITE panel shows installation

The unexpanded rivet at the left is ready for driving. At center the rivet has been driven in and expanded. At right is a cross-section ballooned out with compressed air to make it clinch as firmly as if it were done by the old-time battering method

RIVETS Emerge in Plastics Form

By S. H. Phillips

Process Engineer, Douglas Aircraft Co., El Segundo Plant

From Airplanes to Furniture Upholstery, Many Important Uses are Found for These New Tenacious and Vari-Colored Fasteners

THE brilliant future of post-war plastics is being continually strengthened by research and development fostered by war conditions. Post-war industries will inherit and benefit considerably by finding a wealth of new materials and methods which will find wide application in civilian production. A recent step in this direction was the development of a new method of attachment; a plastics rivet that offers peculiar advantages in certain fabricating practices. Considerable development work by engineers at the El Segundo Plant of the Douglas Aircraft Company preceded announcement of the rivet, and though original intentions were to use it for possible application in aircraft work, they are by no means confined to this. They have considerable potential use in many other industries.

The most interesting feature of the new plastics rivet is the method of installation. Riveting in the most common sense conjures a picture wherein the rivet is clinched in place by battering one end. The new plastics rivet is installed by the simple expedient of employing compressed air. A few pounds per square inch of pressure being all that is required.

In design, the rivet shank and head may conform to any of the innumerable rivet patterns. The color will depend upon the plastic employed in rivet fabrication. An additional step is required in plastics rivet design, however, in that the rivet must be center-bored through the head to provide a means for compressed air application during clinching.

The center-bore is carried to within a short distance from the bottom of the rivet. This forms a pocket into which the compressed air is directed during driving. Just prior to driving, the rivet is heated to a predetermined temperature to soften the plastic. When it is inserted for driving, and compressed air is applied through the center-bored head, the nether end expands or "balloons." This expanded section hardens immediately and clinches the rivet firmly in place.

Brief analysis of the above description will denote that plastics rivets may be installed where only the head is available for the clinching process. This makes possible installation of the rivets in enclosed structures where the nether end is not available for the usual "bucking" or mechanical clinching operations. (*Continued on page* 85)

"Rosie the Riveter" uses compressed air to install the plastics rivets and avoids fatigue, strain and danger

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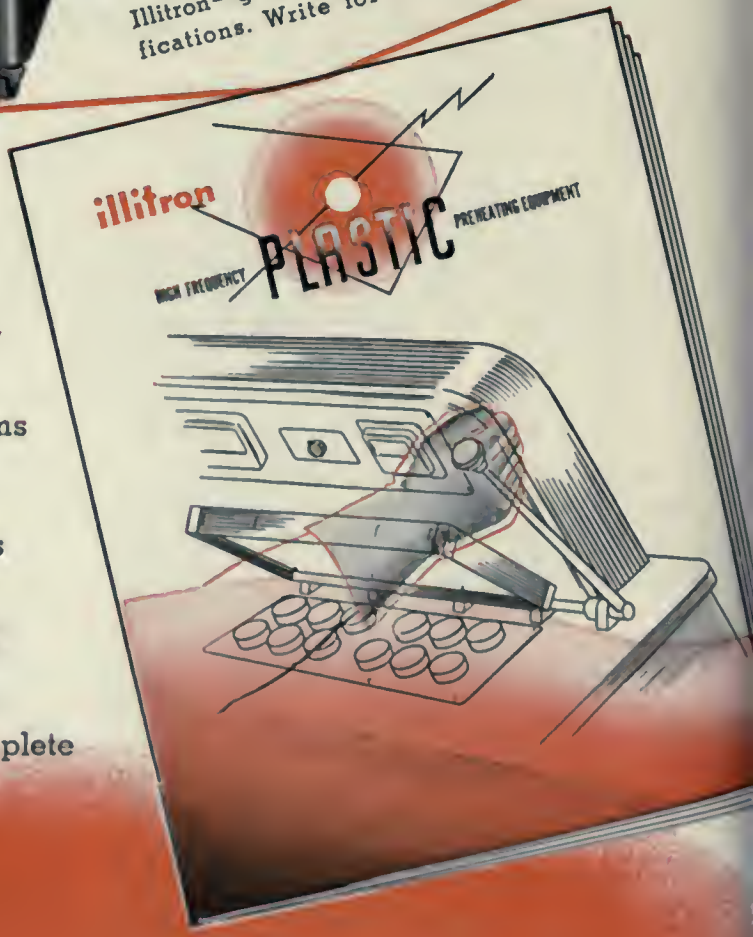

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Closures Molded from Extended Phenolics

By F. J. Donohue and M. A. Brown, Jr.
Monsanto Chemical Co., Plastics Div.

Satisfactory Wartime Applications of New Materials May Lead to Permanent Uses in Many Post-War Developments

MOLDING compounds with phenolic resin content partially replaced by extenders made their appearance in this country shortly after supplies of phenol became inadequate for all military and civilian needs. Plant facilities for this chemical were strained by demands from the pharmaceutical, petroleum, dyestuff and allied industries and from certain of our allies who use it in a favored type of high explosive. It was found possible to allocate phenol only for plastics and resins used in military applications and for some highly essential civilian applications.

In addition to these classes, however, there are certain semi-essential applications where established production lines or packaging methods depend on a supply of molded phenolic parts. In these cases, conversion to other materials would involve disruption of an industry or at best, far-reaching revision of methods involving additional equipment and the replacement of the plastic with an alternate critical raw material. Bottle closures are the most important example where phenolic parts are essential to continued operation. Many packaging applications are set up specifically to utilize phenolic closures. Against this background, extended phenolics were commercially developed.

Lignin or related materials were adopted as extenders to conserve phenol in compounds intended for these essential uses. The use of lignin depends on its ability to replace part of the phenolic resin in the formulation, without necessitating an equivalent reduction in filler. Extended phenolic molding compounds have alleviated this situation. Compounds normally used for closures were formulated of resin, accelerator, lubricants and wood-flour filler. The filler does not enter the chemical reaction and there are definite limits on the extent to which a compound can be filled, 50% usually being taken as the top practical proportion for this type of procedure.

Lignin occurs widely in vegetable growth. It is the principal binder in wood, where it acts as a cement to bond the cellulose fibers. Large supplies of this natural raw material are available from paper manufacture which usually utilizes only the cellulose, leaving the lignin in paper mill waste liquors. Other sources are in sawmill and other wood wastes.

Attempts to utilize lignin alone, or with fillers as a plastic molding material have been of limited commercial importance because of less favorable properties than well established types of thermosetting materials based on synthetic resins.

Intensive research has developed lignin, however, as an extender for use in conjunction with phenolic resin. For this purpose, the lignin is chemically modified to enable it to react with formaldehyde. This chemical modification consists of hydrolysis which adds OH groups analogous to the OH group in the phenol molecule. In manufacturing, the hydrolized lignin is compounded with phenolic resin, filler and coloring matter. Lignin as an extender thus replaces part of the phenol that would otherwise be used.

Lignin-extended phenolics have been found satisfactory in closure applications which represent substantial proportions of pre-war usage. They are adaptable to high-speed automatic molding machines, although not without some sacrifice of speed and finish.

For moderate extensions, flow and cure are adequate for small and medium sized parts. Mechanical strength is good but water and alcohol absorption are higher than for standard phenolics. Because of higher water absorption, electrical properties are not as good as those of standard phenolics.

(*Continued on page* 101)

Precision Models Sell Bulky Equipment

Production Costs are Cut Sharply by a Newly-Developed Technique Which Utilizes Plastics Molds for Making Authentic Selling Models

By Richard Latham

Research Engineer,
A. Steven Lewis Associates

PRESENT indications are that the post-war salesman of bulky equipment, such as tractors, trucks, machine tools, power house installations, construction machinery and the like, will be enormously aided in his task by authentic small scale models of the equipment he offers.

The idea of using precision models for three dimensional selling of large units of this nature, instead of depending on photographs is, in itself, not new. But what is new is that today plastics molds have made possible the development of a revolutionary technique of casting metal models on a low-cost, short-run basis.

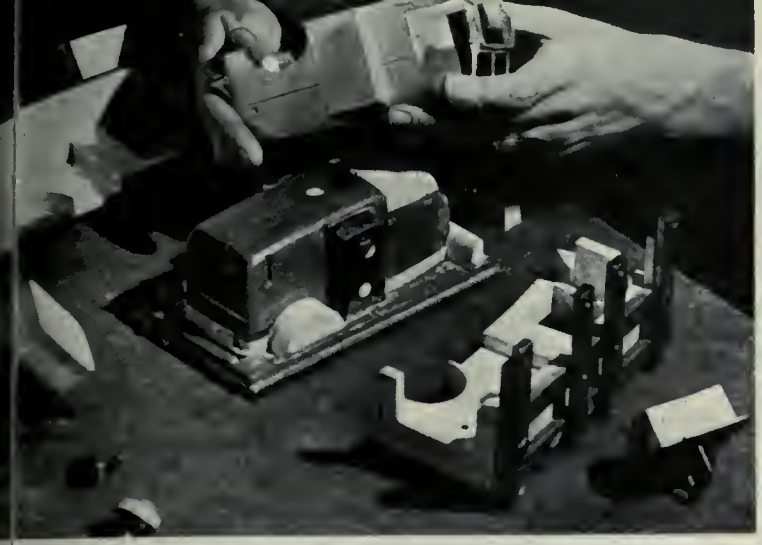
And it is these two factors that give this technique its wide possibilities. For previously, neither hand-made models, nor those made by steel dies, filled the need. Hand models were costly and involved much time. Steel dies, except in extremely long runs, were equally expensive.

The need for a new method was brought to our attention by some of the best known manufacturers and museums in the country for whom we have been making precision models of the hand-made type for many years. Posed by this demand for low cost models produced in short runs, we decided last year to take a large percentage of our staff out of production and delegate to it the task of licking the problem.

But solving the problem was not easy. The solution came only after almost a year of constant research and experimentation, after many hundred processes and techniques were tried out in our laboratory.

We decided quite early that the most economical way to produce high grade, precision scale models was by casting a lead and tin matrix metal in a plastic mold. The plastic that served our purposes best was acetate butyrate. There were several reasons for this: it was not brittle and worked well under machine tool conditions, it permitted us to build up dies with it, and it was comparatively economical. As plastics supplies become freer, it is probable that we will use many different types.

Now used by the Army to provide a solution to dispersal and storage problems, models such as these may be adopted to many post-war sales display uses, especially where heavy and bulky units are involved



Breaking apart the plastics mold which is used in the making of the Army truck model shown completed on the preceding page

Small parts of models are cast to exceptional accuracy: Shown here is a precise reproduction of a cable reel

Two major problems confronted us from the very start: First, we found that the matrix metal we had decided upon, having a melting point of approximately 212°C, cooled almost as soon as we poured it, and therefore would not flow properly. We tried all of the fluxes normally used and still failed to get an even and complete flow. Finally, we developed a flux in the form of a powder which works very smoothly, and we are now able to make hollow models with walls as thin as 1/32nd of an inch.

Secondly, our early castings showed bad surface crazes, such as might be expected from plaster molds. This was due partly to failure of the matrix metal to flow smoothly and partly to the difficulty of completely eliminating air from the mold during the pouring process. We solved this problem by our development of a powder flux and by perfecting a technique of pouring the metal in such as way as to prevent oxidation.

This technique of reproducing metal models from plastic molds has thus far been used primarily for the armed forces and manufacturers of war material. But the process has already been employed to reproduce small models of machine tools, refrigerators, trucks, cannon, airplanes, fire fighting equipment, etc. And many companies, looking ahead to the day when three dimensional selling will be an accepted technique, have contacted us with regard to reproducing their civilian products for the post-war period.

At the present time, we are making several hundred models of the army's SCR299 Mobile Radio Station for the Hallicrafters Co. The original truck is manufactured by the Chevrolet Co. and most of the radio equipment is furnished installed by the Hallicrafters Co. The model is 9" long, 3¾" wide and 4" high, is built to a scale of one-half inch to the foot and is absolutely accurate in every detail, even to the extent of containing scale reproductions of the receiving and sending radio equipment.

The first step in the making of a model such as this one, is the designing from a pattern of a die that will draw. Once such a pattern is designed, it is sunk in plastic. In a few instances, we have speeded the die making process by building the die up with plastic rather than sinking it. This is a considerably faster and cheaper method and one upon which we expect to rely more and more in the future.

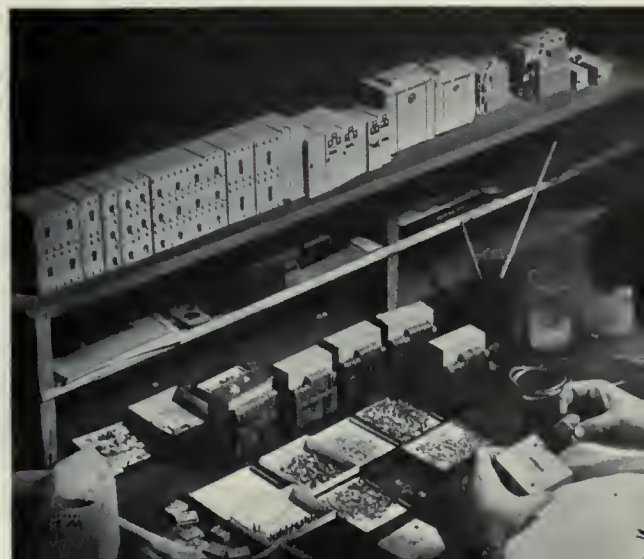
Ten separate parts were necessary to reproduce this truck, three main body parts and seven inserts. The three body parts consist of an inside core, which is a base shaped to form the inside of the truck, and two other molds to form the right and left outside body contours. The inserts consist of seven molds to form the right and left front doors, the main back door, the right and left windshields, and the right and left cable reel holders.

After the molds are completed, they are dusted with our flux powder and fitted together into one over-all mold with the aid of die pins and steel strips. The matrix

(*Continued on page* 103)

Three-dimensional selling in operation: Transformers are typical items in this salesman's kit built for Allis-Chalmers Co.

While the models in this kit are of wood, plastics dies were used for the small parts such as knobs and handles



Carved effects in urea formaldehyde "cake make-up" box and cellulose acetate lipstick container and rouge case

Decorative Applications in the Cosmetic Field

By Margaret Church

Earliest plastics were used for women's beauty articles, and so are the latest

THERE are few industries in which the use of plastics can play a more colorful part than in the cosmetics and beauty fields. Although plastics had attained a substantial proportion of application in the packaging of cosmetics before the war, such use was largely in the form of caps, closures, and wrappings. Their employment as decorative containers for cosmetic products did not become widespread until Government priorities on metals and other materials essential to the war production program made replacement materials necessary. But with wartime restriction, subsequently extending to most plastics, the full scope of their role in the realm of cosmetics (as in other civilian fields) will probably not be realized until the requisite critical chemicals and facilities are available.

Plastics, by nature of their color and form possibilities, lend themselves with particular adaptability to products designed for aesthetic appeal to the feminine consumer. Their lightness of weight, their strength and chemical attributes and their color range constitute sound practical reasons, as well, for their use in this capacity. It seems logical to assume that there would inevitably have been an increasing application of plastic materials throughout the cosmetics and toiletrics fields in any case, as research and experimentation continued to bring the materials to perfection. Indications at this time point to a sustained and amplified use of plastics in these industries—for caps, closures, compacts, vials, tubes and other containers for products of various types.

In many cases the plastics items—resorted to as "substitutes" when the materials originally used became unavailable—have proved superior to the products formerly employed. In these instances, the plastics have progressed beyond any "temporary usage" stage and have become in fact actual replacements. It seems more than likely that this will continue to occur in additional instances as research, experimentation, and availability of materials increase.

Various toilet articles of plastic had appeared on the market a number of years before the war. Notable among these were dressing table accessories, including dressing combs. When the rubber situation became acute, dressing combs began to appear in even greater volume on the market, replacing the scarce hard rubber products.

Certain small ornamental combs, barrettes, and "tuck combs," used to hold women's coiffures in place, had long been made of plastics materials, but these have appeared in new profusion and in color range making them especially decorative as well as utilitarian. The curtailment of steel wire for the manufacture of hairpins and of "bob" pins was largely responsible for an increase in the use of these combs and barrettes. The wire hairpin shortage was also responsible for the development of

(*Continued on page 94*)

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1892

The girls aren't just picnicking—they're making up aerial charts on huge sheets of cellulose acetate

ACETATE SHEETING
Revolutionizes Aerial Charting

By Rufus Jarman

THE Aeronautical Chart Plant operated by the Aeronautical Chart Service, HQ. AAF, and located in St. Louis, has found that plastics, mainly in the form of cellulose acetate, are indispensable in modern map and chart making.

There is only one other item more important in making a map than the plastic, and that is the information contained about rivers, harbors, coastlines, elevations, drainage, and other topographical features which, after all, the map is about in the first place. After this has been gathered, acetate becomes the principal means of transforming the data into accurate aerial charts.

The new and improved aerial charts, made possible through better means of assimilating topographical knowledge and through the use of transparent acetate, have made the air lanes immeasurably safer for the huge military air fleets of this country and its allies. The young flyers have surer guides to their destinations, whether they are going to Rochester or Rangoon, to Indiana or India, to Cairo, Illinois or Cairo, Egypt.

The principal uses of plastics at the chart plant in St. Louis are cellulose acetate employed in photogrammetry, an acetate base for photographic film, and a light, transparent acetate used to simplify the drafting process on new maps and charts.

With the sketchmaster shown above landmarks are projected from photos on acetate base

The great reliance upon the transparent plastics sheeting in tracings, sticking on printed words and symbols suggest even greater applications in post-war for every type of mapmaking, in drafting rooms, commercial art studios, sign shops, photo engravers, etc. The army has pointed the way in its chart and map making procedure.

Photogrammetry is a relatively new science, in which

(*Continued on page* 92)

PLASTICS AT WORK
IN THE HOME

An inflated vinylite tube provides an elastic seat and back for this chair, on view currently at the Museum of Modern Art. In another article in these pages will be found the complete story of this innovation in plastics by William Miller.

Resistance to the chemicals used in spraying plants is offered by the Tenite pump handle and jar cap.

Lighting fixture made of translucent laminated sheets with decorative rings of acetate butyrate. Made by the General Electric Company for the J. C. Varden Co.

Red and white fruit juicer, largely of meth-acrylate, in Museum of Modern Art exhibition. Designed by Barnes & Reinecke for Dazey Corp.

PLASTICS AT WORK IN MUSICAL INSTRUMENTS

This plastics-cased accordion has been developed by the Rudolph Wurlitzer Co.

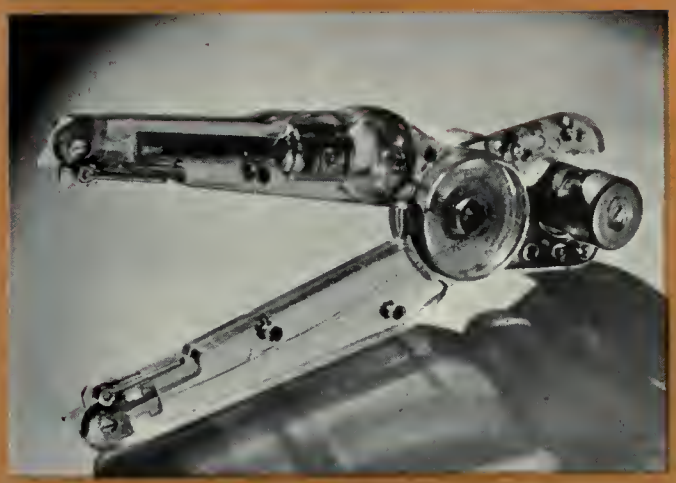
Another butyrate Army instrument is this bugle, molded by Elmer E. Mills Corp., in conjunction with Chicago Musical Instrument Co.

Army successfully uses this one-piece butyrate flle. Made by Penzell, Mueller Co from Extruded Plastics Inc tubing

Batch of Tenite Army whistles complete with sprue and runners, injection-molded by Plastic Engineering

PLASTICS AT WORK IN HANDTOOLS

Tenite handle insulates comparator from heat of operator's hand, keeps his thumb off indicator. Molded by the Precision Plastics Co. for Bellwether Corporation.



Fuse puller made of Lumarith for heavy duty contains bulb which lights up when the fuse being tested is still good. Made by Kuhn & Jacobs Molding & Tool Company for the Star Fuse Company.

Series of standard block gage handles of butyrate replace aluminum and keep heat of inspector's hand from the instrument. Molded by Federal Tool Corp.

Lightweight Tenite housing allows women to operate this rotary pneumatic drill accurately and without succumbing to fatigue. Molded by Reynolds Spring Company for Arco Equipment Corp.

PLASTICS AT WORK
IN SAFETY APPLIANCES

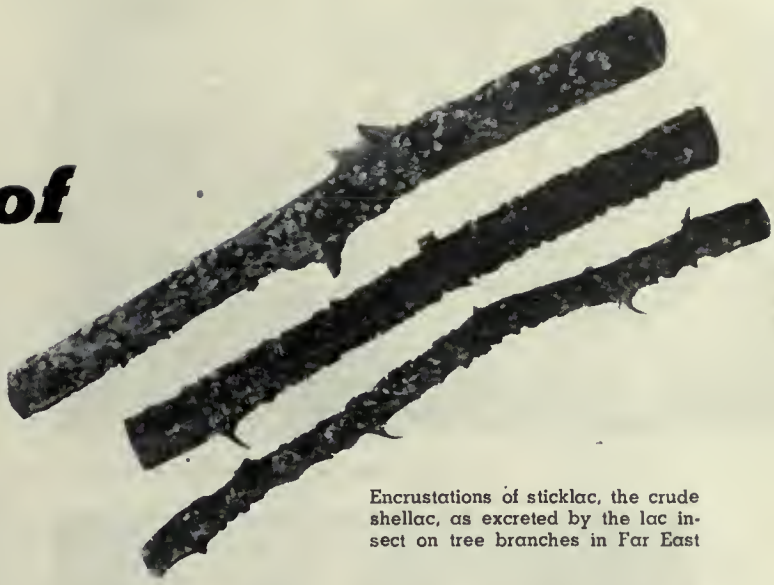
Shatterproof butyrate replaces glass globes in Navy's safety lights. Attached to life belts, their light weight increases buoyancy. Molded by Gemloid Corp. for Sculler Safety Corp.

Device for charging barbed wire fence has Tenite housing through which motor and signal light can be seen. Made by Eclipse Molded Products Co. for Northern Signal Co.

Transparent Celluloid housings on battery cells of this portable searchlight permit quick check up of their condition; weigh a third as much as rubber they replaced.

Shellac and Development of Substitutes

By Lewis Winner
Market Research Engineer



Encrustations of sticklac, the crude shellac, as excreted by the lac insect on tree branches in Far East

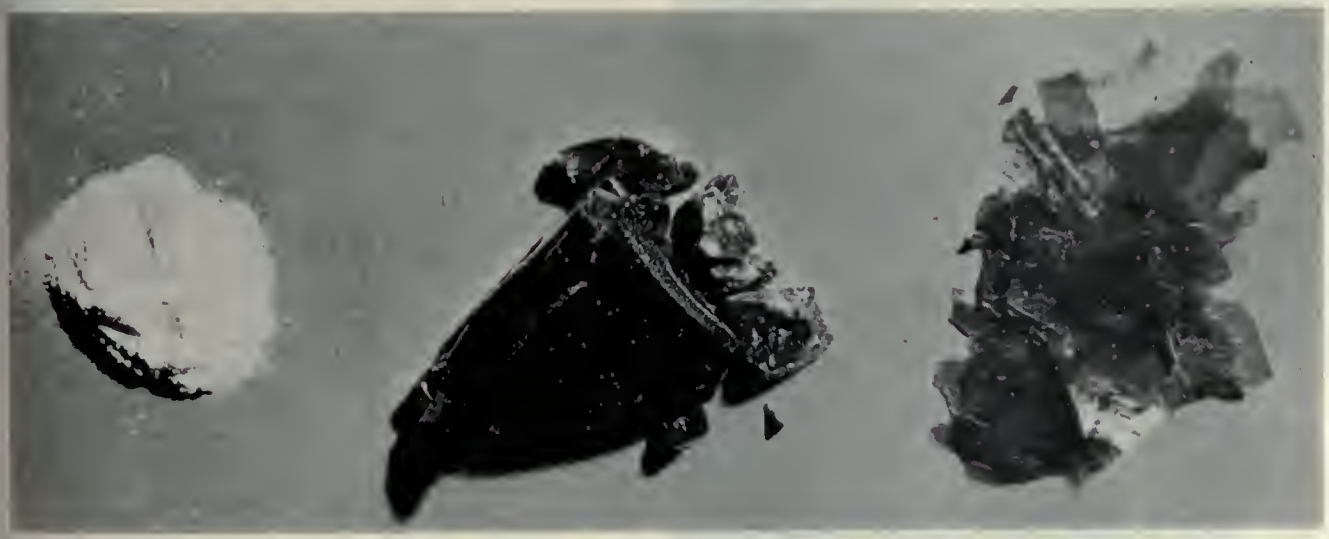
Phonograph records highlight the applications of synthetic resins developed as shellac replacement

FEW substances have been responsible for so lengthy and intense a search for a substitute, as shellac. The search which began more than 40 years ago and, incidentally, propelled the development of Bakelite in 1908, was prompted by the same problem that faced this country when war began . . . a shortage. The conditions which caused that initial shortage were, however, quite different than those in 1941 when normal ocean routes from Calcutta, main export port for shellac, were cut. Shellac moldings were being introduced as a substitute for hard rubber; shellac had not only proved itself an effective replacement, but a particularly economical one.

During the intervening years many industries continued the search for shellac substitutes. When cellulose nitrate lacquers made their debut, it was thought that they would replace shellac as a rapid-drying varnish. However, instead of shellac replacing the lacquer, it complemented it, and both became accepted materials for coatings.

The development of radio in the early 1920's so appreciably slowed the rapid rise of phonograph records which used shellac, that there was a corresponding decrease of interest in the search for a shellac substitute. However,

Stretching shellac: This process is followed by annealing, slow cooling and then breaking up into thin flakes



Shown at left is zein, protein shellac substitute. Center: Luckite, another substitute. At right: Pure shellac flakes

Biscuits of shellac on steam table, before being put on press

View above shows the shellac moss prior to pressing with master record. Below, record has just been pressed: note the flash

the introduction of combination radio-phonographs, automatic phonographs, and the use of records by broadcasting stations caused phonograph record sales to soar once again. Demand for phonograph records and other materials using shellac reached a peak in 1941, and this country alone consumed from 10 to 15 million pounds more than the world's total shellac production of that year. This consumption would have been impossible, of course, except for the large carry-over of lac produced in previous years. This increased civilian demand, plus the new demands of the military and the interruption to shipping from India, posed a serious problem.

The need for substitutes became critical, and laboratories once again intensified efforts to find replacements for shellac. The development problems that existed when the original shellac substitute programs were begun appeared again, since shellac is a rather individualistic substance. It is the only commercial resin that is obtained from animal chemical reactions.

A small beetle, known as the lac bug or Tachardia lacca, which lives on trees, secretes the lac resin from which shellac is made. This parasite thrives only in India, Burma, and Siam. According to shellac specialists, it takes over 1,500,000 of these beetles to produce sufficient resin for a pound of shellac.

New Synthetic Resin

Earlier tests revealed that shellac combined all the virtues required in a phonograph record. It was hard, tough, easily molded, extremely economical and it could be reused. It was able to withstand the tremendous friction developed at the point between the needle and the record. Thus, any substitute had to parallel these characteristics and, in addition, be applicable to the chemical and mechanical features of the procedures used to produce records with shellac.

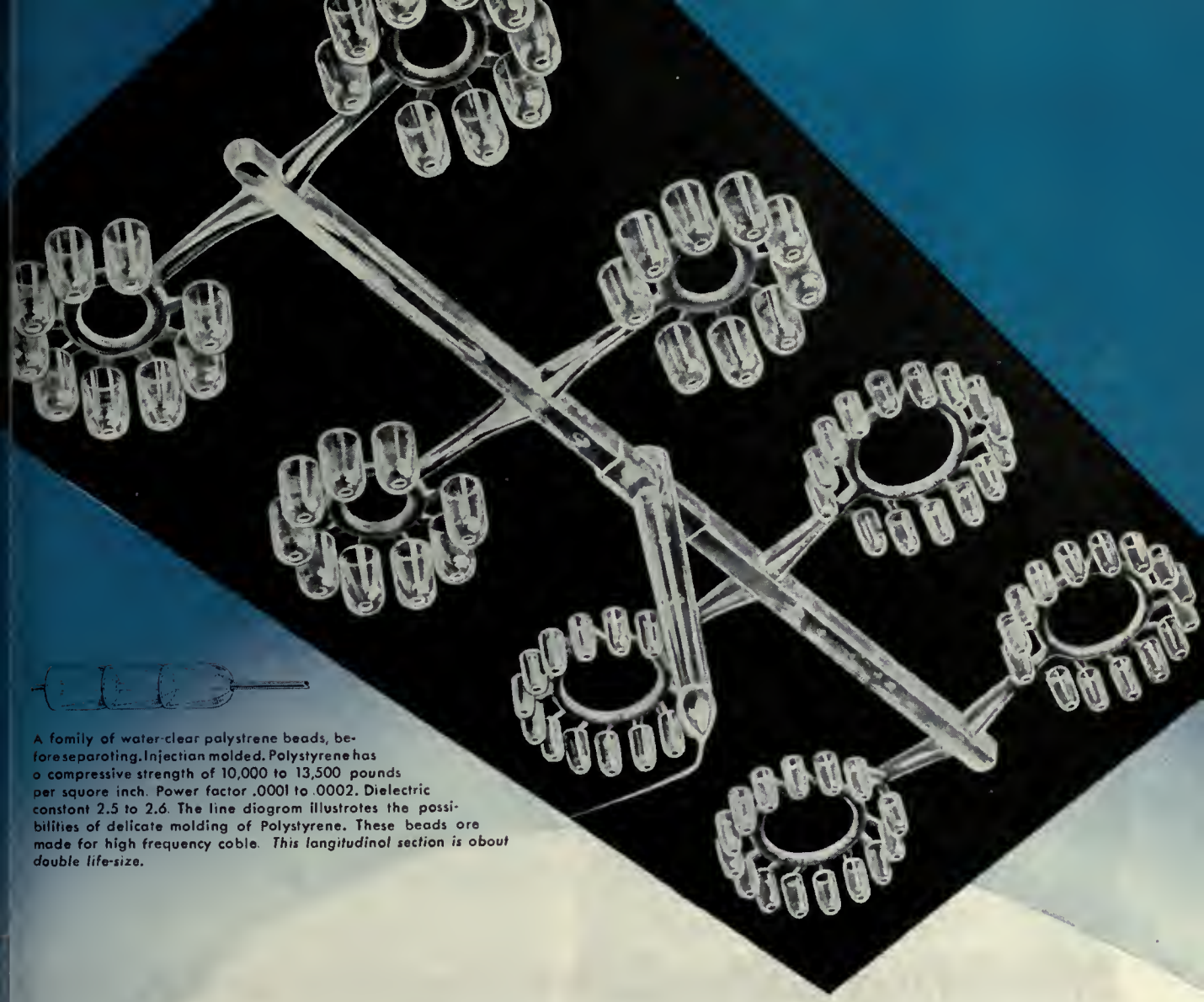
During the past year chemists have provided means of extending shellac as well as replacing it. The extenders in most instances involved the use of scrap of a grade that would fuse with the original shellac used. The replacements have consisted of materials resembling shellac and others having shellac characteristics, but they required production methods different from those used in shellac record manufacture. In the latter category we find the vinyls and polystyrene. Both of these materials, incidentally no longer have the cost factor as a major problem. Styrene, for instance, is now available at about 30c per lb., while vinyl-acetate costs about 55c per lb. compared to shellac which sells for about 40c per lb. Another of their virtues is that they are thermoplastic. Cellulose acetate is a fine material for recordings but it has the general disadvantage of needle "drag" which limits constant reproduction use.

A recently developed material that appears to have effective shellac replacement properties is an amorphous synthetic resin, Luckite, Formula 7-11-A. The Musicraft Corporation reports that it can be introduced into any formulation that used shellac and allied ingredients. It is a thermoplastic which uses non-critical materials, and is being sold at 38c per lb., with the possibility that this price may soon be reduced.

Fillers and Processing

In the manufacture of recordings with the synthetic resin, certain copals, rosin, cotton flock, carbon, and bone black, nigrosine dye, and mineral fillers are used. Hardwood pitch may be added to produce cheaper records. Red clay, which is an iron aluminum silicate containing considerable silica, is the filler used most often, but fine slate flour or a similar composition may also be used. According to the Luckite chemists, some manufacturers prefer

(*Continued on page 96*)



A family of water-clear polystrene beads, before separating. Injection molded. Polystyrene has a compressive strength of 10,000 to 13,500 pounds per square inch. Power factor .0001 to .0002. Dielectric constant 2.5 to 2.6. The line diagram illustrates the possibilities of delicate molding of Polystyrene. These beads are made for high frequency cable. *This longitudinal section is about double life-size.*

Synthetics for Industry

In the handling of plastics a complete knowledge of the characteristics of the various synthetics, their possibilities and the technique of working with each is fundamental. That is equally true of *experience* and *skill* and up-to-date equipment. With all of these, Amphenol, has consistently been a leader in this rising industry.

Practical experience in molding synthetics for industrial use dates back, at Amphenol, to the days, many years ago, when "plastics" meant Bakelite. Today Amphenol has batteries of up-to-date injection molding, compression molding, and extruding machines—many specially designed and custom built.

The help of Amphenol's engineers in the choice of materials, planning and designing of products is available to those interested in keeping step with the times in the use of plastics.

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One of Amphenol battery of injection molding machine

Molded eyeballs before finishing (left); acrylic molding powder (right); all-plastics eyes in foreground

Making Life-Like Artificial Eyes

By Dr. Richard I. Jackson

Dept. of Chemistry, Northwestern University

New technique for molding and fabricating artificial eyes of acrylic plastics produces natural appearance and greater comfort

AMONG the many new uses of plastics that have been accelerated by the war, one of the most interesting is the fabrication of artificial eyes from acrylic resin. This new development was started three years ago by Fritz Jardon, the owner of a dental laboratory in Kansas City. After several months of development work, he became affiliated with a glass eye dealer and the manufacture of an eye consisting of a glass iris button inbedded in a plastic shape was started.

Due to the great difference in the thermal co-efficient of expansion of methyl methacrylate and glass, difficulty was experienced in keeping the plastic and glass from separating. This separation, which often occurred during the last steps of manufacture or when the finished eye was subjected to jarring, heat, or excessive humidity, resulted in an objectionable sheen over the iris.

Although this sheen difficulty did not, by any means, invariably form in the glass-plastic combination, it persuaded Mr. Jardon to start the Mono-Plastic Eye Company for the manufacture of all-plastics artificial eyes.

The development of an iris color to replace the glass previously used was carried out in co-operation with Dr. Reuel Bennett, a well known research photographer and optometrist. Dr. Bennett's specially built equipment and his exclusive methods for photographing the human eye enabled them to produce virtually a photographic reproduction in color of any human eye. Other new developments, necessitated by the all plastic nature of the eye, were worked out by Mr. Jardon and Dr. Bennett with the aid of Conrad Noelle. The three are co-authors of a recently applied-for patent covering these developments.

The manufacture of the Mono-Plastic eye starts with

After removal from the mold, the eyeball is carefully abraded to remove the fin left by the parting of the molds

A cavity is ground into the scleral portion in precise dimensions to accommodate the acrylic iris "button"

After insertion of the iris "button," its edge is blended into the scleral to remove any sharp unnatural lines

The entire eyeball is again placed in the molds to be integrated and resurfaced in a casting of clear acrylic

the molding of a shape. This shape is white or faintly tinted and conforms to the final shape and color of the human eye. It is made from granular methyl methacrylate polymer, containing added pigments, and monomeric methyl methacrylate liquid. The two are mixed and molded by the technique customarily used for dentures.

A depression for the insertion of the iris button is next ground into the outer surface of the shape and the surface, in general, is ground slightly to make room for the clear plastic overlayer that is to follow. The iris button containing the iris colors is next inserted. The depression and fine vein-like markings are placed around it. A layer of crystal clear methacrylate molded to the outer surface of the shape forms the corneal portion of the eye and the clear film-like overlayer already mentioned. Grinding and polishing operations complete the manufacture.

The manufacturers have not revealed to me exactly how they achieve "depth" and complexity in the iris markings or their methods for applying the veins, blending the

(*Continued on page* 88)

The surface is buffed to a smoothness comparable to that of the natural organ and compatible to the live tissue

For reading charts in the dark, an envelope of cellulose acetate dyed with a fluorescent material gives glow-warm illumination when it is placed under ultraviolet light

Plastics Serve as a Fluorescent Medium

By J. M. Gordon
Lion Manufacturing Corporation

Cellulose Acetate Now Used Both as Inexpensive Source of Ultraviolet Light and as Transparent Luminous Envelopes

THE phenomena of ultraviolet light reacting on fluorescent materials has been lifted out of the spectacular and put to essential, practical use through plastics serving in related jobs. First of all, a plastic has provided an inexpensive source of black light, and secondly, plastics have provided the vehicles to carry fluorescent materials into a multitude of unprecedented uses.

With a plastics filter an ordinary fluorescent tube becomes the inexpensive source of black light needed for dial and sign illumination, safety guides, inspection lamps, and in X-ray equipment. Some promise is indicated for use in medical diagnosis as certain skin diseases, notably ringworm, and certain organic matter fluoresce under ultraviolet light.

Radio dials and automobile dashboards will benefit by improved illumination due to the research in the fluorescent use of plastics. In this respect, Lion Manufacturing Corporation, Chicago, Illinois, has developed a cellulose acetate of dark blue color which permits the passage of a high percentage of the near ultraviolet rays while it screens out most of the rest of the spectrum. Made into a tube, this plastic becomes a collar for an ordinary white fluorescent tube light. It filters out visible light and becomes a valuable source of black light at low cost. This plastic, made to special specifications and dyed with a secret formula, has a high melting point and enough stability so that it is in no way affected by the heat of the fluorescent lamp.

In the post-war world, there will be innumerable applications in vast quantities for black light. In pre-war days mercury vapor lamps were used that cost about $12.00 and which not only emitted a great deal of heat but also required the use of an expensive transformer. Possibly, the cheapest lamp was a 50 w lamp made of a filter glass bulb that could only be used intermittently since it gives off intense heat. Another type, a 4 w fluorescent lamp made of ultraviolet filter glass costs about $3.00. The same lamp with plain white glass costs less than a third as much. This is due to the fact that the black filter glass is so brittle it is difficult to mold. It is believed that in production the white fluorescent lamp will cost no more than 20c and the plastics filter developed through Lion could be produced for about 10c. Together they would cost only a fraction of the price of the black glass fluorescent lamp.

Even considering a lower price on the nickel cobalt glass in production, estimates are that the white bulb and cellulose collar will be anywhere from one-third to one-fifth less. This is most important. The savings on each bulb may not appear to be very great, but the plastics filter brings the combination down below the point where black light is no longer prohibitive in large scale applications. While a manufacturer would not consider a bulb

at a dollar for his hundred thousands of automobile dashboards or radio dials, he would be interested in a black light source that would cost about 30c.

There are no claims that the plastic collar filter over the tube light is as efficient a black light source as the black glass tube light. But though the plastic filter emits 25% less black light, even on the smallest bulbs it produces enough for most practical purposes. And though the plastic allows about 20% more visible light to pass through it than through the ultraviolet dark glass, not enough light is visible from the plastic combination to be at all objectionable for most uses. Therefore, it may be maintained that more than enough black light will pass through the plastic filter while so little visible light will appear it will be unnoticeable.

In addition, the plastic collar arrangement offers two advantages: The collar can be so opaqued, leaving only a small slit for the passage of ultraviolet rays. The collar can then be revolved around the fluorescent tube so that the black light can be directed and confined for certain uses. For instance, a radio manufacturer is considering a dial arrangement whereby each wave length band will fluoresce separately. To accomplish this novel and useful effect, the plastic collar can be revolved so that the narrow slit will project its beam to light only one band of the fluorescent numerals at a time. A simple arrangement will turn the collar on the bulb and bring the required wave band into glowing illumination. The collar arrangement can also be made to transmit white light or no light at all.

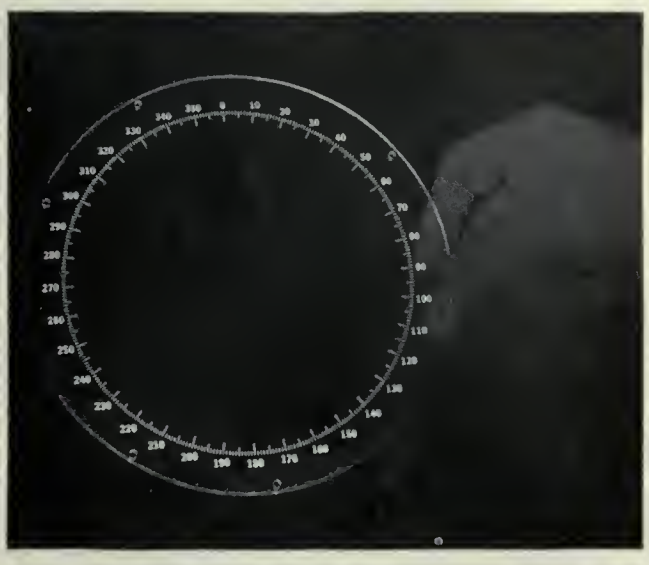
Many Novel Uses Possible

A stove manufacturer has found another use which brings out the advantage of the plastic collar arrangement. He wishes to use a fluorescent tube to light the rear recesses of his stove. The filter can be placed over this tube covering only one end. In this manner, most of the white light will illuminate the stove when required while a portion will be used to throw black light on a number of dials which will glow at readings of oven temperature, the time, and other indications.

The use of a plastic in connection with a fluorescent tube presages the novel use of many colored plastics over neon tubes in post-war signs. The possibility of a practical and inexpensive ultraviolet light opens a vast new field for lighting everything from Christmas trees to safety warnings.

The adaptation of a transparent plastic as a fluorescent material *through* which even fine maps can be read, shows the way to its use as a protective illuminator of every description. Imagine corridors lit by the plastic wall protector!

For reading navigation charts in the dark, there was developed a fluorescent envelope. Within a shielding folder



Figures on dial read easily in black light

Instruments can be used conveniently in the light emitted by the fluorescent envelope

of black lignolite treated with a plastics impregnant to resist moisture, a pocket is formed of a fluorescent cellulose-acetate sheet. This transparency is dyed with a fluorescent material. Under ultraviolet light everything placed under the sheet of cellulose can be read without any visible light. The surface plastic is treated so that pencil marks may be readily traced and quickly erased without touching the surface of the maps visible through the luminated envelope. This fluorescent envelope can also be used under white light or daylight.

Many applications of black light have aided the war effort. Pilots, navigators and other ships' officers, to whom there would be (*Continued on page* 100)

Plastics filter on a fluorescent lamp makes possible the utilization of high percentage of near ultraviolet light, providing a low-cost black light for a wide variety of applications, including illuminated radio dials, neon signs, automobile dash-boards

Drs. Reid Fordyce and David T. Mowry, Cerex discoverers, boil two plastics combs. Their plastic passed the test

This reaction unit worker at Monsanto is joining organic molecules to produce plastics Cerex for war equipment

A New Thermoplastic with High Heat Resistance

Chemists See Injection Molding Process Opened to Broader Applications

THE search for a thermoplastic capable of retaining its shape and strength in boiling water has met with success in a material called *Cerex* developed by the Monsanto Chemical Co., according to a report issued by Charles Belknap, president of the company.

The new material is said to have an ASTM heat distortion point of 220° F, described as higher than that of any thermoplastic hitherto available, and to show a water absorption gain of 0.3%. It can be molded without addition of plasticizer and at no higher temperature than existing thermoplastics.

It was discovered by Drs. Reid Fordyce and David T. Mowry, working at the Central Research Laboratories of Monsanto, in Dayton, O., of which Dr. Charles A. Thomas is director.

The water absorption characteristics of a plastic effect dimensional stability because a molded part tends to warp and distort as it absorbs or releases moisture. Absorbed moisture has an additional effect on dimensional stability by lowering the heat distortion point.

Present Materials

Cellulose acetate, the first thermoplastic used as an injection molding compound, suffers from all these shortcomings. Plasticizer content is high, water absorption is high, and ASTM heat distortion point even in the hardest moldable formulation is low.

Some other cellulose esters and cellulose ethers are improvements. Cellulose acetate butyrate requires less plasticizer than acetate and has about half the water absorption, but the heat distortion point is still relatively low.

Further improvement is noted in vinyl compounds. Molding formulations of rigid vinyl chloride acetate do not require plasticizer and have low water absorption. Their heat distortion point, however, is low.

The dimensional stability of methyl methacrylate and polystyrene is superior to that of other present thermoplastics. Neither require plasticizer for formulation into moldable compounds and both have low water absorption. The heat distortion point of methyl methacrylate is low, however, about 140° F, while polystyrene has a heat distortion point of 169-176° F. In certain polystyrene formulations the heat distortion point is raised about 15° F by the addition of chlorinated diphenyls but with sacrifices of transparency, color and mechanical properties. Heat resistant acrylic compounds are available in sheet form with ASTM heat distortion point as high as 185° F.

(*Continued on page* 93)

9 WAYS TO BETTER POST-WAR PACKAGING

HOW TO PACK WAR MATERIALS

HOW TO SEAL

HOW TO STACK AND LOAD

HOW TO SELL

HOW TO MERCHANDISE

HOW TO SHIP

HOW TO SHIP BY AIR

HOW TO SPECIFY

HOW TO PREPAK

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association activities

SPI Holds Annual Conference

Dr. Stuart D. Douglas on right is presented the Hyatt medal by Dr. C. S. Marvel. Center is Dr. G. K. Scribner

MEMBERS of the Society of the Plastics Industry were presented with a well-balanced program at their annual conference recently held in Chicago.

They heard pointed comment on the labeling of plastic products sold to the general public. Materials men learned a thing or two about plastic and glass combinations and were witnesses to the christening of "Geon Resins." They were also let in on the secret of *Polyfibre*, hitherto restricted—a paper which also opened up vistas to the molders; and the machinery men had a jam session of their own.

Two new kinds of insulation were thoroughly discussed—an application of polyethylene and a near relation to plastics made of mica and glass. Another paper gave an over-all picture projected into the future, while representatives of the War Production Board were on hand to tell about the effects of plastics availability, right here and now.

Hyatt Medal to Dr. Douglas

The conference was not all devoted to "information, please." Aside from the election of officers, members had the experience, so pleasant to men of good will, of honoring a man of rare talent. That experience came with the awarding of the John Wesley Hyatt gold medal for distinguished achievement in the plastics industry to Dr. Stuart D. Douglas, head of Plastics Research, Carbide and Carbon Chemicals Corp., for his studies on the polymerization of vinyl resins.

These researches, largely on controlling the conditions of polymerization so as to yield substantially uniform polymers of high molecular weight, which Dr. Douglas has carried on over a period of 17 years, made possible the extensive production of vinyl resins for many war time uses.

The medal award, reinforced with $1,000 in cash, is sponsored annually by the Hercules Powder Co. Dr. Douglas is the third recipient of the honor.

To let out what the military have kept secret for good reasons—*Polyfibre* was revealed as a material compacted of fin

E. E. Mills | Dr. J. J. Pyle | Grayson W. Wilcox | Dr. Richard F. Bach | Wm. K. Woodruff | Norman Anderson

RONALD KINNEAR
New Chairman of the Board

GEORGE K. SCRIBNER
1944-'45 President

WILLIAM T. CRUSE
SPI's Executive Vice President

fibers "designed to accomplish the dual purpose of exhibiting a large surface and tending to shrink when subjected to heat," thereby speeding up the process of fabrication.

The quotation is from the paper read by W. C. Goggin, Manager, and R. R. Bradshaw, Molding Engineer, of the Plastics Development Division of the Dow Chemical Co., which developed the product. The particular form of *Polyfibre* they discussed is based on polystyrene.

The matted fibers, up to 5 microns in diameter, provide a large surface per unit weight, so that the material can be heated quickly, while the shrinkage of the elongated, highly oriented fibers provides a self-pressure which eliminates the need of complex equipment for applying pressure, according to the authors.

The low-pressure bag molding process, they stated, thereby becomes commercially feasible for the first time. In their own words: "Large-size thermoplastic moldings can now be obtained with inexpensive equipment and low-cost molds without the use of high pressure. Secondly, complex contours impractical in compression molding become practical through bag molding. Thirdly, and probably most important in its contribution to thermoplastic fabrication, is the fact that *molding densities can be accurately controlled.* Molded *Polyfibre* densities ranging *from 0.4 to 1.05 are entirely feasible.*"

Several types of mold have been found to give results, according to the report: sand-cast magnesium molds, zinc or other metal sprayed on appropriate wooden or plastic pattern, and spun metal, for symmetrical sections.

The process may be carried out in autoclave, oven or water bath. The third method has the advantage that the time to which the molding is subjected to heat may be closely controlled, because it is a simple matter to transfer it to a second, chilling water bath.

Polyfibre is described as coming in bats 14 by 10", with parallel fibers running crosswise. They are said to offer good low temperature thermal insulation and sound insulation as well.

Among other advantages claimed for the new material by Messrs. Goggin and Bradshaw are controlled specific gravity gradients through the moldings, greatly improved impact strength, new low dielectric constants, and control of directional strength properties.

In his talk on "Informative Labeling" Mr. Scribner, president of the Boonton Molding Company, as well as of the society, proposed "to educate the general public to the fact that there are 12 or 15 plastics, just as there are 12 or 15 metals, and each one should be judged on its own merit in each individual application." This would safeguard the industry in that people who had an unfortunate experience with some particular plastic would not damn the whole species but would realize perhaps that they had used the wrong type for their purpose.

To further this educational program, Mr. Scribner advocated that the plastic type names be shortened—cellulose acetate butyrate to "butyrate plastics," methyl methacrylate to either "acrylic plastics" or "acrylate plastics," and so on. He doubted the wisdom of giving the general public more concrete specifications at the present time.

The following officers of the Society of the Plastics Industry were elected to serve for the 1944-45 fiscal year: Ronald Kinnear, Niagara Insul-Bake Specialty Co., Chairman of the Board; George K. Scribner, Boonton Molding Co., President; M. M. Makeever, Makalot Corp., Director and Vice-President; James B. Neal, Norton Laboratories, Inc., Director and Sec.-Treasurer.

Directors elected for the same period were: N. A. Backscheider, Recto Molded Products, Inc.; K. H. Braithwaite, Duplate Canada, Ltd.; N. O. Broderson, Rochester Button Co.; Howard S. Bunn, Carbide & Carbon Chemicals Corp.; George Clark, Formica Insulation Co.; E. Halbach, The Bolta Co.; W. J. McCortney, Chrysler Corp.; Elmer E. Mills, Elmer E. Mills Corp.; Roy L. Peat, Plastic & Die Cast Products Corp.; F. G. Schranz, Baldwin Southwark Division, the Baldwin Locomotive Works; and Paul C. Tietz, The Richardson Co.

Recent Developments

Dr. J. J. Pyle, of the General Electric Co., discussed the three factors which will influence the trends of the industry. First of these was the increased production and reduced cost of such materials as polystyrene and the vinyls. He described their properties and concluded that, since they were capable of considerable modification and were likely to undergo a relatively large drop in price, they would certainly find an expanding market.

A second factor which would also have that effect, according to Dr. Pyle, was the new applications of plastics. He cited the advances made in narrowing dimensional tolerances on the M-52 fuse, the use of filled or unfilled cast resins for dies and jigs, the application of resins to increase the wet tensile strength of paper, the use of polyvinyl alcohol, urea formaldehyde resins and vinylite for printing, and of pulp preforms to obtain articles with mechanical properties between those of molded and

W. G. Cooper, M. R. Sangerman, C. F. Cummins and H. N. Vickerman exchange ideas on one of the day's addresses

laminated plastics, the post-forming of plastics and the great increase in production of synthetic adhesives.

As a third factor which has extended the frontiers of plastics, Dr. Pyle considered new or improved materials. As examples, he referred to the development of HM-122 Lucite to overcome the heat deformation under load which has handicapped most thermoplastics, "solventless varnishes" or "liquid resins," and the "copolymerization of a new monomer and probably styrene" which has yielded a whole series of new materials comparing favorably with polystyrene in many respects—and about which we should like to know more.

Dr. Pyle also considered the increasing importance of low-pressure molding, the use of lignin in laminates, the advent of silicones, and the steadily growing use of cellulose derivatives. "Despite the number of years that cellulose derivatives have been used in plastics, it would appear that the real development and exploitation is only getting under way."

Polyethylene for Insulation

One topic touched on by Dr. Pyle, the use of polyethylene for high frequency insulation, was the subject of a detailed historical study presented to the conference by Hugh C. Crafton, Jr., and Harry B. Slade, research chemist and research engineer, respectively, of the Okonite Co.

The authors showed many tables comparing the physical, chemical, thermal, dielectric, mechanical and other vital properties of polyethylene and polystyrene, polyisobutylene and natural rubber.

The only limitations they find in the use of polyethylene for insulating cables are: 1) its rigidity in moderately thick sections, and 2) its low softening point (104° C), so that an outer jacket "must be applied without heating the cable as a whole above this temperature for any appreciable time." But, they point out, polyethylene itself makes an excellent outer covering.

In summarizing their paper, Messrs. Crafton and Slade declare:

"The conditions for the polymerization of ethylene in the manufacture of polyethylene are as unique as the product itself. These involve extreme pressures and heat hitherto unheard of in commercial scale processes. The fundamental structure and behavior of polyethylene bridges, in some respects, the gap between rubbers and plastics. Many of its properties are superior to either. Being a single flexible material, unencumbered with plasticizers or other processing materials (with the slight exception of the anti-oxidant), it has a great advantage over its contemporary competitors. It is probably safe to say that polyethylene is the most promising dielectric material for cable insulations developed in many years."

Introducing Mycalex

Another type of insulation, called Mycalex, was described by A. J. Monack, Chief Engineer, Mycalex Corp., Clifton, N. J. It is made of finely powdered mica bonded with glass of relatively low melting point and solidified under pressure, requiring no curing time.

At present Mycalex is largely made by compression molding into sheets or rods, occasionally into strips, discs or relatively simple irregular shapes. The term

An informal moment at the meeting. Hugo S. Erickson, A. J. Bachner and L. H. Amrine discuss the agenda

"molded Mycalex", however, Mr. Monack explained, refers to parts "on which no further machining is ordinarily done except removal of the gates by grinding or cutting." No method for extruding the material has been developed as yet.

Compared with organic plastics, Mr. Monack said, Mycalex is heavier, has a much higher softening temperature and a much lower coefficient of expansion. It also costs more than most plastics. A wide variety of metal inserts can be molded into Mycalex, which itself may be molded for insertion in other plastics.

The use of this material is indicated, according to Mr. Monack, "where a low loss factor and high dielectric strength are required in conjunction with close dimensional tolerances, dimensional stability, ability to withstand temperatures up to 425° C, good surface resistance under tropical or similar conditions of temperature and humidity, absence of carbonization in case of arcing, and negligible water absorption. Molded Mycalex is indicated for parts of complex shape, with or without metal inserts, where low dielectric losses and close tolerance on dimensions are essential. High softening temperature, absence of carbonization, and negligible water absorption, are also important."

That wasn't all the conference heard about glass. Frank W. Preston, Preston Laboratories, Butler, Pa., who believes that plastics and glass are natural allies, read a paper on "Significance of New Data on Combinations of Plastic and Glass Fibers."

The data in question were drawn from the experimental work done on glass-reinforced plastics for structural parts of airplanes by the Materiel Command, U.S. Army Air Forces, Wright Field, and the Owens-Corning Fiberglas Corp. The lessons thus learned, Mr. Preston declared, would find extensive peace-time application, for the adaptability of plastic-glass laminates to lightweight construction, rounded contours, sweeping and reversed curves are a challenge to the ingenuity of engineers.

Although substantial results have already been achieved, Mr. Preston considers them a mere beginning and that "we have every reason to believe the ultimate results will be phenomenal."

A New Name for Polyvinyls

For convenience in designating the whole family of polyvinyl resins, the newly created Chemical Division of The B. F. Goodrich Co. has given them the name "Geon Resins". M. Scott Moulton associated with that company as Technical Engineer, Plastics Section, reviewed their properties and processing possibilities.

Mr. Moulton emphasized the versatility of this group of plastics, as evidenced "both in the variety of techniques of application possible and in the wide range of acceptable and, in many cases, outstanding characteristics."

Division Meetings

At the molders' divisional meeting George De Bell, Consultant, spoke on new machinery developments; James A. Lawson, War Production Board, on the current machinery situation; and Sidney Ullman, Office of Price Administration, on maximum price regulation 523. J. D. McDonald, McDonald Manufacturing Co., presided.

The Machinery and Tool Division heard James Neal, Norton Laboratories, Inc., anticipate future developments. F. G. Schranz, Southwark Division of Baldwin Locomotive Works, chairman.

The Button Division held a closed business section, with N. O. Broder-

(*Continued on page* 82)

Dr. Frank W. Preston demonstrated a point concerning a glass reinforced plastic with L. H. Amrine assisting

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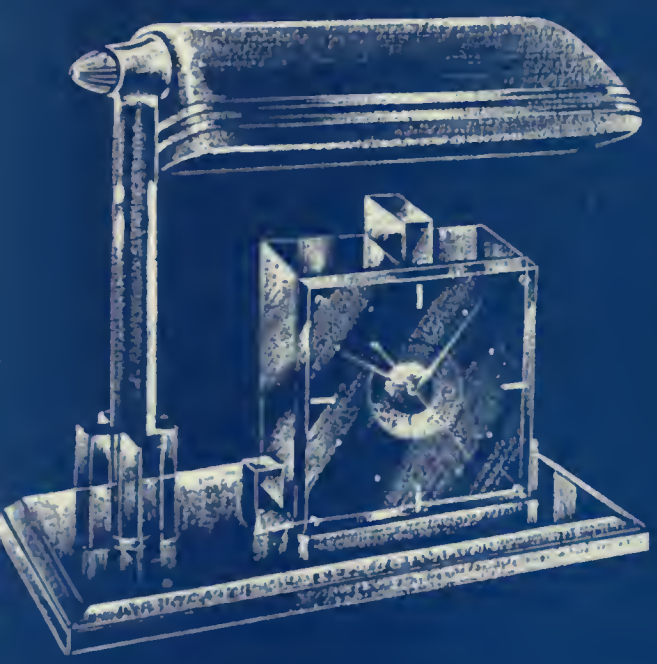
ON THE DRAFTING BOARD

Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

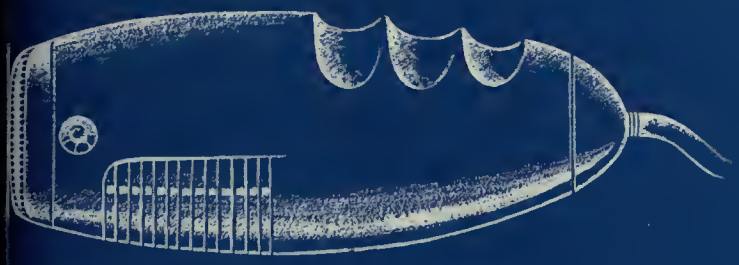
Drawings by Julian Krupa, Plastics' Art Department



By making the above lamp-stand of the same plastic material as the housing of the clock mounted on it, a unity of effect is achieved. Repetition of block motives in both objects enhances their effect. *By Julian Krupa*

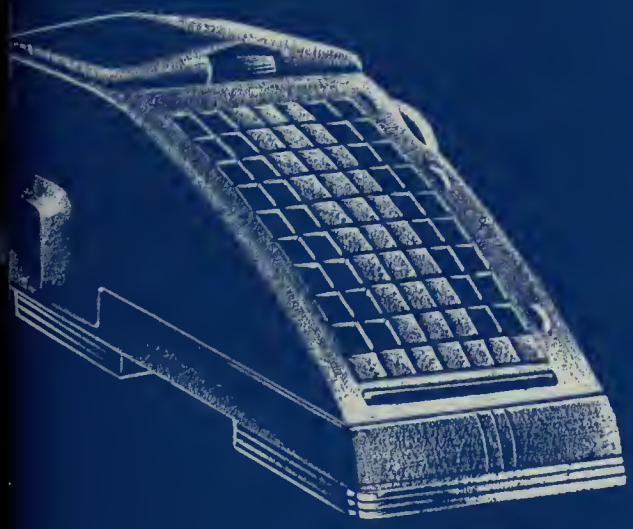
Simplicity of line and color possibilities are the contributions of plastics to this design for a post-war porteble television set. *By Dave Chapman, Chicago*

In the designs shown above and at the right, these electric pencil sharpeners assume decorative values. The plastics housings are not only good looking, but the designs conceal unsightly pencil shavings. *By Plastics' Design Staff*

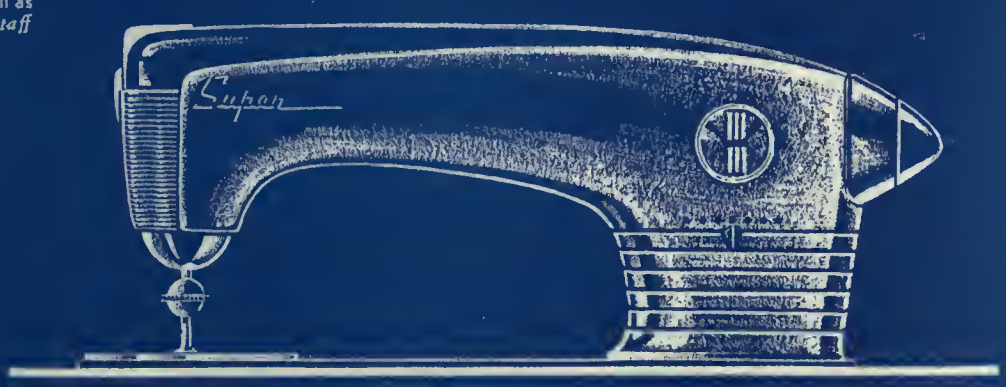


Electric shaver with housing made of urea formaldehyde is molded in two pieces. Inserts for mounting motor and cutting head are formed in same operation. *By James M. Hart, Detroit*

Plastics are basis for all parts of this piano except for the metal sounding board. With successful molding of large plastics parts in the offing, this design may become a post-war actuality. *By Plastics' Design Staff*



Plastics may be used not only for the housing of this adding machine, but also for the keys and tape-winding handwheel. The hardness of the material precludes surface marring of the keys, which are colored to facilitate operation of the machine and at the same time create a harmony of color as well as of material. *By Plastics' Design Staff*



A plastics housing gives this sewing machine the sleekness of form which suggests the lightness and deftness with which the latter day example of Elias Howe's invention performs its function. *By Dave Chapman, Chicago*

CAPITAL Report

By Arnold Kruckman

Plastics' Washington Correspondent

IN discussing material substitutions and supplies the Conservation Division of WPB, in its latest statement, emphasizes that "a number of plastics are easier." The materials most plentiful are cellulose nitrate and lignin. Next come those which are sufficient within the limits of controlling orders, the materials listed being cellulose acetate, cellulose acetobutyrate, melamine aldehyde resins, melamine aldehyde molding materials, phenolic molding materials, phenolic resins, polystyrene, urea aldehyde resins, and urea aldehyde molded materials. Synthetic resins and plastics which are insufficient, and which should be replaced wherever possible by substitutes or lower grade materials are acrylic resins, alkyd resins, ethyl cellulose, polycthylene, and vinyl resins.

Many Scarce

Among the chemicals identified with plastics the most abundant at the moment is pentaerythritol. Those sufficient, but limited, are acetic acid, acetone, amyl chloride, butyl cellosolve, chlorates and perchlorates, cresols, dichlorethyl, formaldehyde and paraformaldehyde, hexamethylenetetramine, all ketones except methyl-ethyl and methyl-isobutyl, lactic acid and lactates, pentaerythritol of nitration grade, nitric acid, phenol and derivatives, phosphorus pentoxide and oxychloride.

The chemicals that are scarce and should be used only when substitutes are not available are acetaldehyde, acetic anhydride, all the alcohols, benzol and its derivatives, butyl acetate, diphenyl amine, dipentene, ethyl acetate, furfural, isopropyl acetate, methyl-ethyl and methyl-isobutyl ketones, maleic acid and anhydride, monoethanolamine, tricresyl and triphenyl phosphates, phthalate plasticizers, phthalic anhydride and derivatives, pyridine, styrene, toluol and derivatives, and urea. It also is reported that there is a limited sufficiency of abietates, casein, chemical pulp cotton, cellophane, and cellulose sponges.

Chemicals Bureau of WPB reports limited allocations of anhydrous aluminum chloride, diacetone, glycol ethers, phosphate plasticizers, stabilized rosin, and vinyl polymers, during the current month.

There was relatively a long list of WPB Orders the past month which affect the plastics industry. Order M-340 was amended May 12, requiring that the customer must furnish his supplier not later than the 15th day of *the preceding month* a certificate of use for a list of chemicals including Vinsol and Truline and the by-product phosphoric acid of methyl methacrylate.

Order on Sun Glasses

Order M-246, amended on May 9, permits anyone to receive free samples of the phenolic resins or phenolic resin molding compounds without a specific authorization in any quantity. This does not apply to resins containing para tertiary butyl phenol and para phenyl phenol; these may be obtained in quantities limited to 10 pounds a month. The amendment also provides any one person may receive up to 110 gallons (two drums) of phenolic resins or phenolic resin molding compounds for experimental purposes in any calendar month. In case of para tertiary butyl phenol and para phenyl phenol the limitation is 10 pounds per month. Shippers must secure blanket authority by applying on Form PD-601.

Order L-238, amended May 9, changes the control of the thermoplastics used in the manufacture of sun glasses from the amount of thermoplastics allocated, to the number of sun glasses which may be produced. Manufacturers are now restricted to 90% of the number made in any quarter of 1942. Purchase Orders for Army, Navy, and Lend-Lease are not charged against the quota, but 75% of sun glasses for Army or Marine Corps post exchanges and for Navy and Coast Guard ships' service departments are charged against the quota.

On May 5, Allocation Orders M-357, metallic sodium; M-170, styrene; M-170-a, polystyrene; M-215, glycol; and M-260, acrylic monomer and acrylic resin, were revoked. The action was taken to place all these materials under General Allocation Order M-300. The shift is expected to simplify paper work. In the transfer it is required that hereafter users of metallic sodium must specify they use the chemical for the purpose for which it is allocated. The same Order for the first time brought under allocation control, as of June 1, dichlorostyrene and polychlorostyrene, new materials recently developed. They are most generally used for high frequency electrical installations. Small-order exemption for triethylene glycol was raised from 250 pounds to 600, and for mixed glycols from 250 to 1,000 pounds. Certain intermediate quantities of glycols above the specified exemptions must now be supported by the customer's use-certificate in place of Form PD-600. The Order now contains the procedure by which acrylic monomer and acrylic resin may be obtained for military use without a directive.

Safety Equipment

PR3, Direction 5, amended May 3, prohibits the use of AA-1 and AA-2 blanket MRO ratings for a number of chemical materials. Among them are acetonyl acetone, various aluminum and ammonium products, butyl aldehydes, dichloramine B & T, all ketones except methyl, ethyl and methyl isobutyl; hexachlorobenzene, methyl cellulose, nitrocellulose, triethanolamine, urea peroxide, and others. Those who have them may use production ratings. Those who have a blanket MRO AA-1 rating may use AA-2X. Those who have a blanket rating of AA-2 must use AA-3. If you cannot get materials you require on the rating you possess you must apply to the nearest WPB office on WPB-541, formerly PD-1A. Until May 3 orders for a large number of chemicals including those used in the plastics industry were limited to requests for materials to fill orders already on hand. An amendment issued on May 3 to Order M-340 permits a manufacturer to obtain materials on the basis of *expected* orders.

Order M-114, covering manufacture of safety equipment, gives producers more freedom in use of materials, and removes restrictions on the use of plastics, as amended May 1.

On April 15 export quota of fine acetate rayon yarn was increased from 2% to 4%; this includes the requirements of the Canadian Commodity Prices Stabilization Corporation. The amendment re-defines rayon fabric and export orders, and gives a new definition of nylon. Nylon now also means fibers, yarn, thread and fabrics. Rayon fabrics are further defined to mean combinations or blends containing more than 50% by weight of any synthetic yarns. An export order, as defined in General Preference Order

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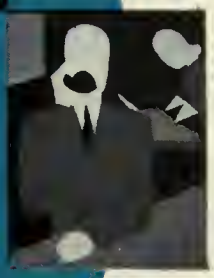

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M-37-d, bears a rating of AA-3 or higher; and, applying to rayon fabric, AA-5, when the material is covered by an FEA export license, a release license issued by FEA, a U. S. Treasury contract or requisition for FEA (Lend-Lease), a purchase by the Canadian Commodity Prices Stabilization Corporation, and deliveries to Army, Navy, Maritime Commission or War Shipping Administration.

On April 11, M-307 was amended to increase the small order exemption for casein from 1,000 to 2,000 per month. Incidentally, 26,000,000 pounds casein will be made available to the coated paper industry this year. It is 5,000,000 pounds larger than last year's consumption, but 11,000,000 pounds less than the restricted use in 1941.

Suggest Reduction

In early May we were informed here that the reduction in the price of formaldehyde in tank car lots amounted to 40 cents per 100 pounds, and in packaged sales 25 cents per 100 pounds. The Alkyd Resin Industry Advisory Committee of WPB, exploring ways of conserving alkyd resins, recorded that present expansion of the production of phthalic anhydride would scarcely take care of the increasing needs of the military. This lead the Committee to suggest that the phthalic anhydride content of alkyd resins, used for protective coatings, be reduced from the present 33% maximum to 20%. Chemicals Bureau advised the Committee there was some hope it might be possible to allocate some phenolic resins to the end uses now denied alkyd resins because of the short supply of phthalic anhydride. Reduction of phthalic anhydride will not reduce drying speeds, but will affect durability.

Military uses of vinyl resins have practically removed them from civilian production schedules. WPB emphasizes there is no immediate prospect of improvement. Chemicals Bureau also stresses that plasticizers, if anything, are even tighter than vinyl resins. A report to a meeting of the Pyroxylin and Vinyl Resin Coated Fabric Industry Advisory Committee revealed that raw materials are even more acutely necessary in England than in the United States.

Stanley H. Gaines, Office of Foreign Agricultural Relations, U. S. Department of Agriculture, reports Brazil now has 98 plywood factories in operation and 134 in process of installation. The 98 operating factories have a gross capacity of 989,399 cubic feet monthly, and the 134 new factories have an estimated capacity of 2,826,890 cubic feet per month, additional.

Speed Up Made

Practically all the Brazilian plywood factories are located in the States of Parana, Santa Catharina, and Rio Grande de Sul. The industry is an outgrowth of the war. Brazil has used plywood for some years; but the big jump came when England sought plywood for temporary construction during the war.

U. S. Department of Agriculture has put much speed on the production of Norelac, the thermoplastic resin which it has developed at its NOrthern REgional Laboratory at Peoria, Ill. As is evident the first two syllables of the name are derived from the Laboratory. The last syllable is the first three letters of LACquer. It is processed from any vegetable oil rich in linoleic acid. Soybean and linseed oils have mostly been used. It has been used increasingly in war materials, particularly in lamination, moisture-proof cellophane, aluminum and lead foil, glassine, and in kraft and sulfite papers. It is very adhesive, resists water, alkali, acids, vegetable oils, and many organic elements.

The Eastern Regional Research Laboratory of the U. S. Department of Agriculture has greatly expanded the development of production of methyl acrylate by converting lactic acid. Lee T. Smith and his associates of the Bureau of Agriculture and Industrial Chemistry have found that acrylic esters obtained in this process can be polymerized in mass, water emulsions, or in organic solvents. The wide diversity of these polymers in properties are revealed in the production of adhesives, adhesive tapes, coating materials, and in the manner they may be applied to textiles, paper, leather, wood, plaster, and other products.

Approximately 2,000 items made of plastics were shown at the plastic age exhibit in connection with the First Chemurgic Clinic held at Oklahoma City, Okla., the middle of May. Most of the exhibited pieces and specimens had some connection with the Federal Government. There were three general divisions: plastics in industry; plastics in the home; and plastics in the war. The show covered 3,000 feet of displays. Both the show and the meeting were sponsored by the National Farm Chemurgic Council, of Columbus, Ohio. It sprang from the tremendous enthusiasm and curiosity about plastics developments evinced at the March meeting of the National Farm Chemurgic Council.

Practically all of this conference was devoted to discussions of various major phases of plastics in business and in the home. Thermopane, new insulating glass, was shown at this conference and at others. It is made of two panes of glass with hermetically sealed dry air between them. Libbey-Owens-Ford Glass Co., Toledo, anticipates it will be used to insulate industrial buildings, seal buildings for air conditioning and take the place of storm windows.

Forest Service, Department of Agriculture, has a patented urea-plasticized wood formula it calls Urraloy. It is described in pamphlet No. R1277 which may be obtained by writing to Forest Service, Department of Agriculture, Washington, D. C. Patents 2,298,017, 2,313,953, and 2,343,016 are available to anyone who can use them. The use is free. An application must be sent to the Secretary of Agriculture, Washington, D. C.

Grain Allocation

Thomas J. Craig has retired as Chief, Protective Coatings Branch, Chemicals Bureau, WPB. He was succeeded by Wells Martin, his deputy in the Branch since 1942. Martin is from Chicago. In addition to assuming direction of the Branch, Martin also becomes head of the Section for Natural Resins and Naval Stores. Benjamin H. Belcher is the deputy chief of the Branch and keeps his old job of chief of the Coatings Section. Dr. Henry O. Farr is assistant to Mr. Belcher. Thomas J. Starkie becomes chief of the Pigment and Color Section, with Charles Love as his assistant. Ralph T. Urich is chief of the Synthetic Resins Section.

Those who require more than $350 worth of new fine grit silicon carbide abrasive grain in any two month allocation period beginning May 1, must make application on Form WPB-2781, in compliance with Order M-319 as amended. They define fine grit silicon carbide as grain of the following sizes: 280, 320, 400, 500, 600, 1F, 2F, 3F, 4F, XF, SF, and STF or DCF. Reclaimed grain is not included. No application need be filed for this grain in grit sizes coarser than 280. Unfused or levigated alumina, and natural abrasives such as emery, garnet, corundum, and flint are not subject to the Order.

Cellulose Sponge

Corundum is exempted up to 25 pounds per month in the finely ground category of all sizes, provided the consumer does not have an inventory in excess of his average 60-day consumption, under amendment to Order M-84.

Army Air Corps in Washington shows a photo of a portable igloo, for Arctic shelter, made of two thicknesses of vinylite plastic-coated cloth separated by a layer of glass wool insulation. The vinylite resin coating withstands continuous exposure to wind, rain, snow or sunshine, and does not crack at temperatures as low as 50 degrees F. The whole 800-pound set-up is snug, dry and warm, and can easily be transported by truck.

Army use of cellulose sponge runs to enormous quantities, it is reported. Important application today is in the wings of bombers to make them fire-proof against escaping gasoline, when punctured by bullets. The sponge soaks up the leaking gasoline. Fine-pore cellulose sponge was found superior to sponge rubber or latex foam. The plastic sponge used does not soak up water, due to special treatment.

Other uses include washing and cleaning of equipment, swabbing guns, sponging down horses and mules. The fine-pore sponge is used to polish glass. Small sponge is used to put camouflage make-up on jungle-fighting soldiers. The sponge is made of viscose, wood-pulp base, similar to material used in rayon and cellophane. END

Will PLASTICS Work Miracles?

It sometimes seems that way, but plastics are not expected to replace older materials in all industry. Instead, these synthetic products will be used where their specific properties give them an advantage in the final product.

The possibilities of increased sales from the correct use of plastics cannot be overlooked, but these possibilities will be realized only through a knowledge of the properties of each material—its limitations as well as its advantages—its physical makeup and record in service.

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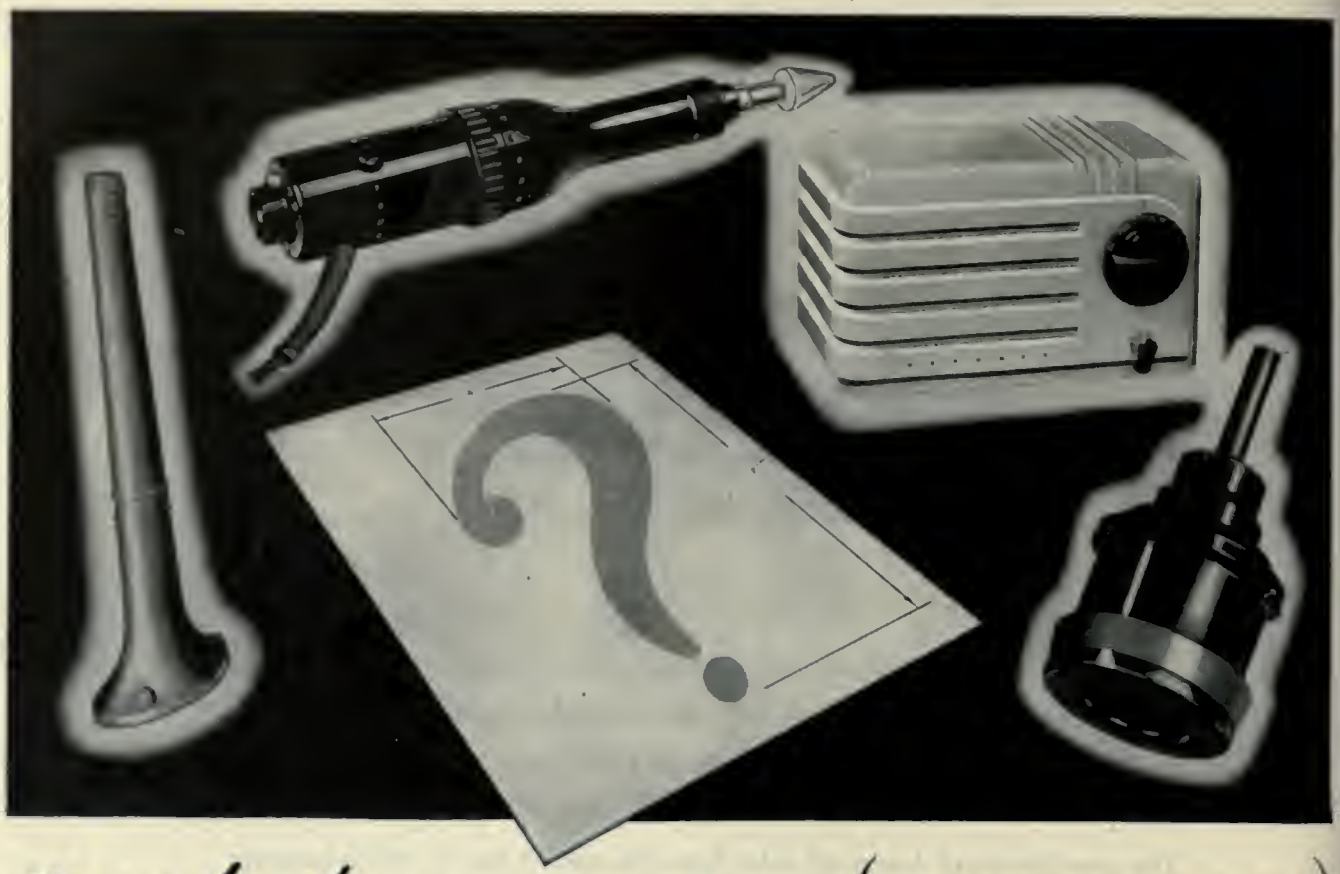

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Extra-strength plastics are proving ideal materials for portable electric tool housings. Their insulating qualities protect the operator; they are light in weight and always comfortable to handle. The Precise 35 Grinder is an excellent illustration.

It is only a few years since plastic radio cabinets were a novelty, but they quickly demonstrated that their rich color and permanent finish carry a powerful sales appeal. In the Detrola cabinet here shown, two contrasting materials are effectively combined.

The plastic molded piston of the famous Sloan Victory Flush Valve has less than half as many parts as its predecessor of brass. Thus, it saves not only scarce metal, but even more vital man and machine hours.

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WHAT'S *New* IN PLASTICS

Preheating Equipment

Illinois Tool Works
Chicago, Illinois

This company's new high frequency plastic preheating equipment has been designed for easier, faster preheating of plastics preforms—for example wood, flour, rag and mica-filled phenolic—and is especially applicable to multi-cavity molds.

The heating is done between plates which are built into the cabinet and open and close similarly to the operation of a waffle iron. The plates are self-adjusting to accommodate preforms of various thicknesses. The movable plate has a heat retainer which maintains the temperature in the preform after the high frequency heating is off, so that greater time is permissible between the preheating and loading of the press.

An automatic timer cuts off the heating after a predetermined time and simultaneously turns off a light on the panel board. A meter indicates in watts the amount of heat per second that is generated in the preforms so that a close temperature control can be maintained.

A manual adjustment can be made whenever the operator changes from one type of preform to another, and a marking on the heat-rate meter will indicate the proper adjustment. This Initial Matching is designed for maximum heating for any type and size of preform within the limits of the unit. Without this proper high frequency matching, it is explained, only part of the rated heating capacity of any heating unit is utilized. A power input control permits the operation of *Illitron* at any power level from zero to its maximum rated capacity.

Safety of the operator is considered in the grounding of the external portions of the circuit, and by switches which cut-off the power when the plates are open. Working space is provided by the table top.

Advantages cited are reducing the preheating time, lowering the time cycle of the press and causing immediate closing to increase production capacity. Also, it is explained that press pressure is greatly reduced because of a uniformly "mushy" preform and there is little possibility of insert and die breakage. A uniform and improved flow improves tolerances. .....(23)

Multi-Contact Timer

The R. W. Cramer Company, Inc.
Centerbrook, Conn.

Where sequence operations are of prime importance, this new device can automatically direct machine activities. It is designed to control a series of operations in definite order, to reverse or alternate the actions of groups of motors or machines, to operate a series of signals, valves or solenoids in a predetermined sequence and to perform other similar controlling acts.

A remote control momentary start button has the additional function of stopping a cycle at any time and then continuing it or repeating it. .....(24)

X-ray Inspection Unit

North American Philips Co., Inc.
New York, N. Y.

An inspection unit for use on the assembly line or in the laboratory, the *Norelco* electronic *Searchray 150* is designed to disclose flaws, cracks or foreign matter in plastics products or in hard rubber, steel, copper, electric parts or aluminum.

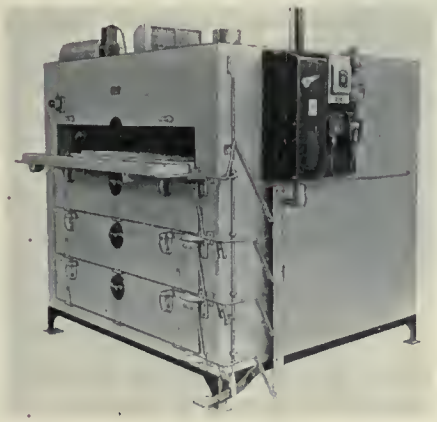
The machine operates on a 220-volt 60 cycle single phase a-c power supply and will give sharp definition of defects at one-minute exposure. Different degrees of depth penetration into the object are determined by exposure time and by the screens used.

For examination, an object is placed in the specimen compartment of the machine and positioned. .....(25)

Shelf-Type Oven

Koch Industrial Equipment
Evansville, Indiana

The shelf-type oven, suitable to heat various size plastic sheets, facilitates forming of gun turrets, enclosures and other shells for aircraft. Each of the four compartments of the oven has two shelves capable of accommodating two full size sheets of material simultaneously. A handy foot pedal closes the door, eliminating excessive heat loss. Positive cross-flow circulation is provided by a circular fan set to insure an even temperature throughout. The oven can be operated at 200 to 400° F. .....(26)



Shape-Turning Lathe

Monarch Machine Tool Company,
Sidney, Ohio

This latest *Shape Master* is described as capable of doing the most intricate of shaping and forming work, turning, boring and facing and can be used for dies for glass or plastic dishes as well as oval-shaped bottle molds and punches or spinning chucks for silverware and hollow ware of all types. An original mold can be duplicated as many times as needed to put the product on a mass production basis.

Of three elements in the mechanism, one controls the shape cut, another the rate of repetition of the shape on any given circumference, and a third the contour generated on successive diameters. The tool-actuating mechanism, mounted on the carriage crossbridge

in place of the usual compound rest, is cam-operated.

The master cam itself records only a single element of the desired design or pattern, whatever its shape. In a fluted dish mold, for example, the master record would represent the curvature only of a single flute.

Repetition of the shape to be cut is determined by the geared relationship of cam and spindle revolutions. A single motor powers both, and the machine has been provided with sufficient change gears to give a range up to 500 shapes or tool actuations per revolution of the work. The machine also makes its own master record cams.

The overall contour of the work can be manipulated in two ways. A stroke compensating device maintains the same shape over a constantly increasing or decreasing diameter of the work piece. Irregular contours can be obtained by the use of a metal template. .....(27)

Tray Stacking Posts

Horder's Inc.
Chicago, Ill.

Made of E. I. du Pont de Nemours and Company "Plastacele," these posts are a transparent and water clear semi-rigid plastic. Because of their design they permit automatic compensation for any inaccuracies in the construction or thickness of wood trays. The trays can be placed together firmly to guarantee that they will not fall apart accidentally and the assembly is described as being able to stand hard wear. .....(28)

Matchbox Compass

Bakelite Corporation,
New York, N. Y.

This Bakelite pocket compass is now standard equipment for Navy life rafts. Designed originally for civilian use from general purpose phenolic molded material, it is now produced from medium impact resistant phenolic molded plastic to meet rougher needs of wartime usage.

It consists of a waterproof plastics case for holding matches, a striker bar at the bottom of the case to produce sparks if the match supply runs out, and a compass at the top of the closure. The material has been shown to be tough, moisture-resistant, and unaffected by temperatures ranging from —60 F° to +160 F°. As this phenolic material is free from electrostatic properties, it does not affect the operation of the compass.

It is molded by General Products Corporation, Union Springs, N. Y. for the Taylor Instrument Companies, Rochester, N. Y. .....(29)

Pocket Protector

Hurley Smith
Buffalo, N. Y.

This transparent plastic device is designed to save wear and soilage of shirt and suit pockets. It fits into the pocket and folds over the edge to provide a place to anchor pens, pencils, or small tools. The item has been in the development stage for a year and is now reported ready for volume sales. .....(30)

True Colloidal Latex

The B. F. Goodrich Company
Akron, Ohio

Achievement of this latex made from a *Geon* vinyl chloride resin in water and without the use of any organic solvents is expected to increase the use of this resin according to Goodrich chemists.

It is offered for use in coating textiles, wire and other materials, film manufacture, treatment of glass fibers and fabrics, protection of leather, manufacture of gloves and other rubber latex products, and mixing of corrosion resistant paints. It is obtainable for experimental use at present but is now under allocation by the WPB.

Among the advantages cited are safety from flammable and toxic solvents, utilization of existing equipment which cannot handle other forms of vinyl resins, elimination of expensive recovery systems for applying resins from solution and precluding use of critical solvents.

The new latex in clear or colored form can be brushed, sprayed, or dipped and the list of practical uses is expected to expand continuously. Already tests have shown that it can be made to conform to fiber structure, allowing the fibers to "breathe."

As a flexible coating it can be used on paper to serve in packaging meats and oily foods such as milk and lard. Chemical resistance, non-toxicity, greaseproofness, resistance to aging, and heat sealability are thereby obtained.

Also, its use in protection of military equipment from corrosion and insulation of electrical wires or cables may replace other methods, chemists think. (31)

Lumarith Starter Handle

Celanese Celluloid Corporation,
New York, N. Y.

One of the latest products to be made from *Lumarith* plastics is a double handle grip used on Bendix airplane cranks and known as an inertia starter handle.

It has a deeply grooved outer surface designed to provide a good grip. Use of the Lumarith plastic is reported to conserve large quantities of critical rubber and also combines high impact strength with light weight.

The grips are extruded by Whiteford Plastics Company, New York, and were designed by E. E. Kazimir, Plastics and Rubber Engineer of Eclipse Aviation Division, Bendix Aviation. *Lumarith* is a Celanese Celluloid Corp. product. ..(32)

Wet Belt Surfacer

Porter-Cable Machine Company
Syracuse, N. Y.

This new *Model AG-8* rigidly constructed surfacer is offered to meet requirements of accurate high speed machining. Stressing greater coolant capacity the machine is equipped with a 35 gal. self-contained recirculating pump system to provide coolant for all grinding operations.

Tolerances as close as 0.0005, a new joggle type switch for easier tracking of belts, a higher table for the operator's convenience, and a flexible tube for extra "spot" coolant are features described.

It is used for grinding steel, aluminum, bronze, glass, plastics, fiber, hard rubber, and ceramics in order to eliminate such hazards as heating, warping, discoloring, flowing and chipping. .....(33)

Armoply Prefabrication

United States Plywood Corporation
New York, N. Y.

This material combines plywood, plastics used as adhesives, and light metal of paper thickness. It was originally used for U. S. Army "powder boxes" and is now being adapted for construction of houses and other structures by a new technique.

It can be factory-fabricated and used for framework, sheathing and exterior siding or roofing. Units are reported as light, flat and easily packed.

U. S. Plywood explains that the corporation itself will not enter the building field, but offers the technique to the prefabricating industry. It has, however, constructed for the Goodyear Tire & Rubber Company a demonstration house. ..... (34)

Precision Marking Dies

New Method Steel Stamps, Inc.
Detroit, Michigan

These dies, made by a process of pantographic milling, are described as providing close tolerances for precise marking of calibrating lines.

Four lines form the central square in the dies and are held to a tolerance of 0.002" measured from the exact center of each line. It is pointed out that an accurate square is assured since there are four points of crossing.....(34A)

Suction Lifting Device

Welded Products Co.
Syracuse, N. Y.

To speed up efficient handling and protect workers from cuts and scratches, Welded Products has designed these suction lifting devices for work with plastics and with other smooth nonporous materials.

Pressure causes the suction cups to adhere and then a slight touch on a patented finger-flip attachment permits instant release. A wide variety of models are available including a special type for lifting and feeding blanks to presses. They have one or more replaceable cups, oil resisting if specified. They lift weights up to 180 pounds. .....(35)

Key Magazine for Key Men in the Aviation Industry

IF INDUSTRIAL AVIATION seems *exclusive*, that's because it exists only for two groups of men—the men who design, specify or buy for aircraft production—and the advertisers who must *get to them*... who must get action by placing the facts about their products or services before one or more key production men in many busy plants. For these advertisers INDUSTRIAL AVIATION produces maximum sales results at lowest possible costs.

That INDUSTRIAL AVIATION is closely read by key men in the aviation industry was proved when it appeared as a special section of "Flying"—the active interest and positive response in a few months made it necessary to bring out INDUSTRIAL AVIATION as a complete separate magazine for its selected subscribers.

Subscriptions are limited to some 15,000 of these key executives. They are the men who direct the *building* of airplanes, engines, propellers. These are the men who influence the *buying* of aircraft equipment, parts, accessories.

In other words, INDUSTRIAL AVIATION delivers the news to the entire industry... as fast as it can be released ...terse, interesting vital news...written *by* experts *for* experts in terms of production methods and design developments. No wonder this magazine ranks the number one place with so many thousands of airplane industrial executives.

Get all the facts by contacting our nearest office. Worthwhile additional information will reach you promptly.

Industrial Aviation EDITED BY PUBLISHING EXPERTS FOR EXPERTS IN AVIATION

Get all the facts *by contacting our nearest office. Worthwhile additional information will reach you promptly.*

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Literature Review

Colloidal & Amorphous Materials

By Warren K. Lewis, Lombard Squires, and Geoffrey Broughton

Many of the new synthetics owe their beginning to the extraordinary developments in the chemistry of materials of high molecular complexity. This book combines a discussion of the theoretical bases of these developments with an explanation of the many industrial applications. It delves into chemical structure, properties and behavior besides supplying vital information about industrial processing of everything from synthetic rubber to amino acids. It is an invaluable reference book for anyone engaged in chemical research or in the chemical industries.

540 pages, illustrated—$6.00. .....(36)

Corn Facts and Figures

Corn Industries Research Foundation
New York, N. Y.

A thorough and accurate study of corn uses in industry and for diet in the United States, this booklet is especially revealing for the plastics manufacturer in showing him how important corn products have become in supplying him his raw materials.

It includes complete statistical charts of corn production, quantitatively and geographically in relation to its industrial consumption. It explains that corn yields more industrial products than any other grain, that every part of the plant may be used and that industrial chemists are continually seeking and finding new uses.

Each of the corn products is analyzed as to its specific industrial use, illustrating that cobs, stalks, leaves, meal, flour, grits, cornstarch, dextrins, syrup, crude sugar, refined sugar, gluten, oil, lactic acid, molasses, butyl alcohol, acetone and ethyl alcohol each have a variety of important uses for plastics manufacture.

To obtain a perspective of the importance of the product, this 46-page booklet, is clearly written and annotated for a quick and comprehensive survey...(37)

By Gum!

Reichold Chemicals, Inc.
Detroit, Michigan

A magazine containing technical information for consumers in the synthetic resin, paint and chemical fields, this leaflet contains informative articles by plant officials.

Volume IV, No. 2, recently published, contains a study of post-war markets for paint, a discussion of color in highway marking and a seven-page treatment of pigment manufacture. .....(38)

Standard Mold Bases

Detroit Mold Engineering Company
Detroit, Mich.

A 21-page booklet on standard injection, compression and transfer molds has been published and is supplemented by the "DME News" which is issued monthly to keep abreast of further developments in DME's standardized mold industry.

The booklet and newspapers are well illustrated, contain complete descriptive information and are well annotated for dimensions and prices.

Mold bases, cavity retainer plates, backing plates, mold plates, spacer blocks and leader pin bushings are among the items described. .....(39)

Production "Cut-backs"

Bureau of Public Relations
War Department, Washington, D. C.

"Adjustment of Production 'Cut-backs,'" a cartoon illustrated folder prepared by the Army Service Forces, explains the careful consideration and detailed planning that the Army does before reducing production or cancelling contracts. .....(40)

Facts for Engineers

Spaulding Fibre Company, Inc.
Tonawanda, New York

This 36-page booklet presents engineering data and suggested uses for Spaulding products. Diagrams, pictures, charts and descriptive explanations of the company's hard vulcanized fibre and their laminated phenolic Spauldite, both of which are made in sheets, rods, tubes and fabricated parts; Spaulding armite, an improved thin insulation in sheets, strips and coils; Spauldo, a motor slot insulation; flexible fibre for gaskets; their fibre receptacles and their fibre board. .....(41)

Tap Extractors

The Walton Company
Hartford, Conn.

A series of information on Walton tap extractors is obtainable, emphasizing their simplicity of operation, immediate delivery and 48 hour free reconditioning service. Price lists are included by sets and by item. .....(42)

Electronic Controllers Bulletin

The Bristol Company
Waterbury, Conn.

Bulletin No. B220 describes a new line of Free-Vane Electronic Controllers for automatically regulating temperature, pressure, liquid level and humidity. It gives wiring diagrams, principle of operation and a general description of the features of the new instruments. .....(43)

Molding Process

Duramold Division
Fairchild Engine and Airplane Corporation
New York, N. Y.

Illustrations, specifications and descriptive materials on the Duramold process of molding is now available in a 12-page booklet.

The product is defined and the processes used in fabrication are pointed out step by step. The booklet suggests also some of the unexplored possibilities for post-war development in molding together pieces of huge dimensions by utilizing the process. .....(44)

Raymond Bulletin

Raymond Pulverizer Division
Combustion Engineering Company, Inc.
Chicago, Illinois

Raymond Bulletin No. 53 gives complete description and detailed parts illustration and analysis of the company's laboratory mill, screen mill and laboratory separator and a description and cross section diagram of their air separator. Included also are detailed instructions for installation, use and care of the apparatus. .....(45)

Transformer's History

General Electric
Schenectady, N. Y.

A performance record of the *Pyranol* transformer and details of its construction, operation and advantages is contained in this 15-page booklet (GEA-4193). It is addressed to plant owners, operators or consulting engineers interested in solving power-distribution problems. .....(46)

Photoswitch Bulletin 316

Photoswitch P Incorporated
Cambridge, Mass.

This four-page bulletin describes Photoswitch Densitometer Series D-90, a recently introduced photoelectric control for transparency measurements of plastics, films, filters, liquids, gases and similar materials.

Five diagrams demonstrate how to arrange different models of the device for making comparative optical density measurements of the subjects being studied. Scales included give the range and accuracy of measurements that can be obtained. .....(47)

Plastic Working in Presses

By E. V. Crane

The third edition of "Plastic working of Metals and Non-Metallic Materials in Presses" tells how and why plastics and metals move and are moved. It explains planning operations, dies and molds, illustrates tools, equipment and methods. To present a broadened view of plasticity and mass production, three chapters have been added along with new material to this outstanding text on the subject.

The appendix contains charts for quick computation of shearing, drawing, ironing, coining and forging pressures, etc. Besides other useful tables and graphical computations it presents and answers the most common problems with which the plastic worker has to cope.

540 pages, illustrated—$5.00. .....(48)

INDUSTRY HIGHLIGHTS

Flame-Resistant Cellulose Nitrate

A promising approach to the problem of rendering cellulose nitrate flame-resistant is reported by the Cellulose Products Department of the Hercules Powder Company, Wilmington, Del.

Under such trade names as celluloid, pyralin and nixonoid, this material has found extensive application in lacquers, fabric coatings and articles for consumer use such as ping pong balls and toilet sets. Ever since it was developed in 1875—first of the plastics properly so-called—the chief drawback to its wider application has been its inflammability.

Many attempts have been made to overcome this weakness. Of the flameproofing mixtures so far tried out at the Hercules laboratories, tricresyl phosphate as plasticizer and magnesium ammonium phosphate as filler and flame quencher have given best results. An example of the type of formulation found to be reasonably flameproof is as follows:

Solids	Parts by weight
Cellulose Nitrate, RS 5-6 sec.	60
Raw Castor Oil	80
Tricresyl Phosphate	40
Magnesium Ammonium Phosphate	80
Titanium Dioxide	10
Luxol Fast Brown R	0.3
Carbon Black	0.5
Solvent	
Denatured Ethanol	24
Tollac	180
Butyl Acetate	216

Although this formulation was not intended especially for flame-proofing textiles, it was tried out on a fabric since coating facilities were available. Tests show that the fabric chars but does not burn when a direct flame is applied.

In the exploratory work to date a fairly extensive list of plasticizers and fillers with known fire-retardant properties has been tested. Of the plasticizers examined, chlorinated paraffin of 42 and of 70% chlorine, and tricresyl phosphate appeared to be most satisfactory. Among the fillers tested were manganous carbonate, biuret, urea, antimony oxide, zinc oxide, and magnesium ammonium phosphate, which gave the best results.

Among the limited tests made were some to determine the effects produced by varying the proportions of tricresyl phosphate and magnesium ammonium phosphate. While holding the cellulose nitrate to magnesium ammonium phosphate ratio constant at 30 to 40 parts by weight, the tricresyl phosphate could be varied from 30 to 50 parts and still give a good workable plastic mix. With less than 30 parts plasticizer the plastic was flame-resistant but not flameproof, while addition of more than 50 parts of plasticizer gave compositions too soft to mold. In the same way, the cellulose nitrate to tricresyl phosphate ratio was held constant at 30 to 40 while the filler, magnesium ammonium phosphate, could be varied from 30 to 60 parts to give a good moldable flameproof plastic.

The results achieved so far are not considered a complete solution of the problem by Hercules. They are published tentatively simply to stimulate further research along these lines.

•

Export of Weldwood plastic resin glue has been resumed after a suspension caused by war conditions, according to W. Robert Goepel of United States Plywood Corporation.

A tapering down of war material requirements, increased production available for civilian uses, improvement in the shipping situation and easing of export licenses were cited as reasons for the change.

A new one-part, cold-setting urea-formaldehyde resin adhesive, this product established a satisfactory foreign market after its introduction four years ago, Mr.

CIBANITE

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CIBA PRODUCTS CORPORATION, 77 RIVER ST., HOBOKEN, N. J.

Goepel said. Now, in addition to its old agents, it will make a bid for more foreign business.

Tropical and South American countries, he forecast, would be particularly attractive prospects as the glue resists insects prevalent there and is proof against bacteria, fungus and water.

•

Continental Can Company, Inc., one of America's largest manufacturers of metal containers and crown closures and producer of fiber containers, has announced the formation of a Plastics Division under O. G. Jakob.

Headquarters of the division will be in New York City and will comprise a Laminated Plastics Department handling *Marco-Board,* a new synthetic resin laminate being fabricated in Chicago and Jersey City plants, and a Reynolds Molded Plastics Department.

The firm has recently acquired the business and manufacturing facilities of the Reynolds Molded Plastics Division of Reynolds Spring Company, Cambridge, Ohio.

Continental *Marco-Board* is a thermosetting contact laminate fabricated from the new MR synthetic resins and produced by Marco Chemicals, Inc., in which Continental has acquired a substantial interest.

To the present, MR laminates have been principally fabricated with *Fiberglas* and cotton duck, separately or together, though almost any substance of a fibrous nature might be used as a filler material.

The product is described as having strength characteristics surpassing those of some of the heavier metals and being essentially unaffected by dilute solutions of acids, alkalis and hydrocarbons. The abrasion resistance is comparable to that of porcelain and the board has high dielectric strength.

Applications suggested are for automotive, building, construction, furniture, luggage, machinery, boat building and decorative panelling manufacture. Advantages cited are its ability to be as easily and simply formed into intricate parts as into flat sheets, its high strength-to-weight ratio, ability to withstand hard usage and to be colored as desired or left colorless to permit a decorative filler material to show through.

•

Goodyear Tire and Rubber Company has established a new Synthetic Sales Division to explore the possibilities of post-war sales and to plan for the company's instant participation in post-war markets. C. P. Joslyn, director of fuel tank contracts, will be head, assisted by H. R. Theis, manager of Plastics and Chemical sales, A. F. Landefeld, manager of Pliofilm sales, O. C. Pahline, director of Flooring sales and H. D. Herbert, Airfoam sales head.

•

Pierce Plastics Co., recently acquired by the Visking Corporation, has moved its manufacturing operations from Bay City, Mich., to the Visking plant in Chicago, the last step in the consolidation of the two companies.

The Plastic Manufacturing Company of California has purchased the entire plastic production, machine shop, tool and die making machinery and the unfilled contracts of B. M. Bodde and will move from its Melrose plant to the new location in Los Angeles. The old location will be used as a storage warehouse and experimental laboratory.

The company manufactures the denture base *Acryco* and specializes in engineering, designing, compression molding, fabricating and cold casting of plastics and maintains a large machine shop and tool and die making department.

Dewey W. Alm, formerly president of Plastex Corporation and more recently associated with B. M. Bodde, has been appointed general manager of the company.

•

Krieger Color and Chemical Company, Hollywood, Calif., announce they have officially changed the name of their plastic dye product, "LUCIDIP," to "KRIEGR-O-DIP." It is being used for dyeing acrylic plastic by the dipping method by many manufacturers throughout the country who are producing special war equipment using plastics that must be colored permanently and effectively. It is also being used by the aircraft industry in dyeing plastics used in highly specialized equipment.

•

The Celanese motion picture, "Proving Ground," given its premiere at the Waldorf Astoria recently, graphically portrays the importance of proper packaging for getting war material to the front ready to fight, and shows how these innovations can be carried over to peacetime use.

The picture is one of the first attempts of raw material manufacturers to help the users of their products to project plans for re-conversion to peacetime production. It is a realistic effort to keep the national income at its high level and avoid the possibility of a re-conversion slump.

PEOPLE

William S. Lang, general sales manager of the Chamberlain Engineering Canada Limited and of R. F. Walsh Co. Ltd., has been elected a director of both companies. He was formerly associated with Dominion Rubber Company Ltd. Chamberlain Engineering is affiliated with the United States Stoneware Company, and has manufacturing rights for Tygon Plastics in Canada.

•

Louis Mansfield Rossi, vice president of Bakelite Corporation, Unit of Union Carbide and Carbon Corporation, died recently in New York, following a sudden illness.

When the General Bakelite Company was formed in 1910, Mr. Rossi was appointed works manager, and in 1919 he was made general manager. In 1923, after the consolidation of the General Bakelite Company, Redmanol Chemical Products Company, and the Condensite Company of America into Bakelite Corporation, Mr. Rossi was elected vice president and director of manufacturing, which position he retained until his death.

•

Felix N. Williams, has been appointed by Monsanto Chemical Company to be general manager of its Plastics Division at Springfield, Mass. The position was left vacant by the recent death of John C. Brooks.

Mr. Williams will be succeeded as production manager of the company's Phosphate Division by E. A. O'Neal, Jr., former plant manager of the Monsanto Trenton, Michigan, plant.

James Anderson was made sales promotion head for the Plastics Engineering Division of Dow Chemical Company and will direct presentation of new plastics products for general sales. He will also head up advertising, publicity, packaging promotion and requisite market information.

•

James E. Sellers, formerly WPB chief engineer, has been named engineering consultant for the research division of Plastics Industries Technical Institute in Los Angeles. Increasing use of the laboratories made the appointment necessary.

•

W. Ward Jackson has returned to Celanese Celluloid Corporation to direct plastics activities in the Washington office after almost two years in Washington as consultant to the WPB Chemicals Bureau. He will continue, however, for several months as WPB consultant to the Project Analysis Branch, the Tax Amortization Branch and the Available Machinery Branch of the Facilities Bureau, WPB Project Essentiality Division.

Felix N. Williams

W. Ward Jackson

plastics overseas

A BRITISH VIEW OF PLASTICS

by Cecil Madden

(Special Dispatch from London)

There is a stage in the development of a material or group of materials which is the crucial determinant of its future. Ths is the point where, after serving in a contributory function to industry, the material must either show its ability to enter the determinative class of materials—that is, materials whose industrial application is so catholic and unrivaled that they exert a compelling influence over industrial trends and manufacturing techniques—or be content to continue in the subsidiary class, where they do what they are called upon to do but have no power to induce the industrial trends that would broaden their usefulness, intensify their research, and increase their potency as molders of industry's shape and development.

Plastics are approaching this stage. From what has been written about plastic materials it might seem that they have not merely approached it, but have won through and are beyond it, but during the past five years plastics have been watched over by some particularly benign influences that will not endure once the war is finished. Their use has been stimulated by supply difficulties in the older materials, and a partly spurious appearance of universality in their application has been provided by the near-death of the competitive factor. After the war, when the supply lanes open up again and when the cost factor again becomes an industrial categorical imperative, plastics will have a new struggle on their hands. For all this, however, industry and commerce have the greatest confidence in, and hopes for, plastics.

The outstanding point about the attitude of British industry to plastics at this stage, when the war is drawing to its end and when everyone is desperately anxious to back the right horse in the post-war running, is the anxiety of the concerns that can get a leg in plastics to do so without delay, and the collateral anxiety of the concerns that see themselves in the road which plastics must travel to build their protective works and establish such defences as they can for their older materials and processes against the coming assault. Paper firms (notably, for some reason, in Scotland) are turning their attention actively to plastics, on the assumption that the new will oust the old in the realms of packaging. Apart from the purely plastics companies, like British Industrial Plastics, British Xylonite, Catalin, Crystalate, Erinoid, Lacrinoid, etc., big organizations like Imperial Chemical Industries, Distillers, and British Celanese are developing substantial subsidiary plastics interests, while separate plastics subsidiary companies are attached to Thomas de la Rue and others. In the industrial middle field, there are a number of concerns, notably Monsanto Chemicals and E. K. Cole, who have important stakes in the new field.

It therefore becomes important to consider whether the preliminary financial and productive set-up does not run the risk of compelling a fundamentally uneconomic development of plastics. There are some observers in London who hold that the cart has come before the horse. Almost any material, fathered as plastics are being fathered, could make a brave show in the resurgent post-war conditions. Without suggesting that plastics may in fact run faster than their native industrial legs justify, it is necessary to consider the restraining influences that would operate immediately if the plastics industry were proceeding on ordinary industrial lines of development that will sooner or later impose their powerful compulsions upon the industry.

(*Continued on page* 104)

"... for high achievement."

Robert P. Patterson
Under Secretary of War

Since 1941 The Metaplast Company has maintained a 24 hour day production for the Armed Forces. Notable applications, ingeniously engineered to meet Army and Navy specifications, resulted in the granting of this award.

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Metal Plating on Plastics

Association Activities

(Continued from page 66)

son, Rochester Button Co., presiding, while the Material Manufacturers Division rested easy with a reception.

The Extrusion Division session, at which Elmer Szantay, Sandee Manufacturing Co., was chairman, was addressed by J. A. Palmer, Dow Chemical Co., on recent developments in the extrusion of polystyrene.

At the business session of the society, there was, in addition to the regular reports, a talk on wartime production of plastics by E. M. Hout, Chemicals Bureau, War Production Board.

One afternoon two entertaining movies in color were shown: "Shape of Things to Come," presented by the Boonton Molding Co., and "The Formica Story," which pictured the work of the Formica Insulation Co.

Among the speakers from outside the industry were W. D. Fuller, president, Curtis Publishing Co.; Col. I. M. Sarayev, Military Attache, U.S.S.R.; John Caswell, Special Representative, Office of Rubber Director; and Dr. Preston Bradley, clergyman, author and radio commentator.

The Hyatt award was presented by Dr. C. S. Marvel, president-elect, American Chemical Society and professor of organic chemistry, University of Illinois, with Dr. R. F. Bach, Dean of Education and Extension, Metropolitan Museum of Art, acting as toastmaster.

Presiding over the various sessions were Norman Anderson, General Molded Products Co.; William K. Woodruff, Celanese Celluloid Corp.; James Johnston, Chicago Molded Products Corp.; Paul C. Tietz, The Richardson Co.; L. H. Amrine, Imperial Molded Products Corp., who delivered the welcoming address; and Elmer E. Mills, of the corporation of the same name, who was general chairman of the committees which worked up the conference.

•

National Plastics Exhibit

A comprehensive exhibit which is to disclose all the secret wartime developments in every branch of the plastics industry has been scheduled for New York or Chicago as soon as the war is over.

Announcement of the exhibit was made by George Scribner, president of the Society of the Plastics Industry, sponsors of the show.

The exhibit will not only include war developments but will also assemble complete data on machines and products throughout the industry.

The project is to be designed to appeal both to the industry and to the public and will be on a nation-wide basis. It is being planned by the Post-War Planning Committee of the organization.

Dr. Willard H. Dow, president of the Dow Chemical Company, was awarded the gold medal of the American Institute of Chemists at its 22nd annual meeting held at the Hotel Biltmore, New York.

Col. Bradley Dewey, Rubber Director, WPB, who spoke on "Dow and the War Effort," pointed out that Dow process plants are making over two-thirds of all the styrene resins used in the production of synthetic rubber. In his acceptance speech, Dr. Dow discussed the meaning of freedom in American life.

Dr. W. H. Dow

Frank Carman

Emphasizing the role of the engineer in determining the future of the plastics industry, Frank H. Carman, general manager of Plastics Materials Manufacturers' Association at a recent meeting of the Pittsburgh Society of Plastics Engineers urged that the public be supplied with good publicity, exact information and products of strength and good workmanship.

The engineer must take advantage of all the new materials and techniques discovered during the production of war products, and must develop the new wartime engineering uses of plastics, he said.

Good publicity means accurate information about the quality uses and potentialities of products, he explained. Care should be taken not to claim more for plastics than they can do. Publicity that does not grant the limitations of a product will quickly make the public look down on plastics and react unfavorably to the industry as a whole, he warned.

He felt that in the post-war period the industry can convert quickly to increased commercial production and can gain a greater percentage of consumer use if the engineer is alive to the possibilities of designing new and already tried plastics household gadgets and other products for which the medium is particularly adaptable.

•

Members of the Cleveland Chapter of the Society of Plastics Engineers were introduced to polythene, its uses and its possibilities by Dr. J. W. Shakleton of du Pont at a recent meeting.

A thermoplastic, polythene is a non-rigid, rubbery solid with a specific gravity of 0.90 to 0.94, he explained. It is very highly acid resistant and has practically no water absorption.

That it can be molded into specific shapes and extruded in tubes, rods and sheets with regular equipment is especially interesting to the plastics molder. Also it can be sprayed and hot dipped on metal, wood, cloth, and such materials. At present it is obtainable only by allocation through WPB.

Polythene, he pointed out, has many post-war uses including wire covering, gaskets, collapsible tubes and containers. Compounding it with rubber, he said, has brought amazing results.

He maintained that if nylon and polythene could be united into one material, the result would be "the perfect plastic".

•

Raymond R. Dickey, manager of the Plastics Division of the Monroe Auto Equipment Company, Monroe, Mich., addressed a Cleveland section of SPE at Akron, Ohio, on "Metal Plated Plastics."

Metal plating plastics is not a cure-all, he said, but it does open new fields and applications for both the plastics and metal plating industries. Though, today all this type production is directed to our war needs, especially in radio for the Signal Corps where conductivity of large areas with low net weight is desired, elaborate post-war plans are under way for mass production commercial application.

The second period of the meeting was conducted by William J. Miskella, chief engineer of Infra-Red Engineers and Designers, Cleveland, Ohio. His subject was "Preheating and Dehydrating Plastics Materials by Infra-Red." Many advantages were unfolded by the application of heat to both thermoplastic and thermosetting materials, he said. It quickens the cure or cycle, improves the finish of a piece, helps to prevent blisters and flow marks and in some cases stops the plastics material from sticking in the mold.

•

The Plastics Association of Chicago held its first meeting of the year at the Hamilton Hotel, 20 S. Dearborn St., recently. H. S. Ruekberg, chief engineer for Elmer Mills Corporation spoke on "The Extrusion and Injection of Plastics."

•

Dr. George O. Curme, Jr., vice president and director of research of Carbide and Carbon Chemicals Corporation, New York, accepted the 1944 Willard Gibbs Medal of the Chicago Section of the American Chemical Society recently.

The Willard Gibbs Medal, one of the highest distinctions in American science, was presented to him at a meeting in Chicago by Dr. Charles L. Parsons.

•

The allocations system of the War Production Board was discussed by its representative, Walter Wagner, chief of the Molding and Laminating Unit, Plastics Branch, at the regular monthly meeting of the Plastics Club of the United States held at the Hotel Pennsylvania, New York City.

ENGINEERING News Letter

By LEWIS WINNER
Market Research Engineer

Applications . . . Methods . . . Materials

A striking display of advanced engineering talents in development, design and production, appeared in several plastics projects shown to your correspondent during the past few weeks.

One was quite a simple item, a flashlight. It was designed by Dohner and Lippincott of New York. It utilizes low pressure molding similar to that employed on our light-weight bombers with laminated plywood that is bonded together with a thermosetting plastic resin. This mode of molding is quite interesting in that it obviates the need for heavy tools and dies. It is also said that the molded material has great resistance and does not dent too readily with abuse. The flashlight shown had only twenty-three parts whereas the ordinary flashlight has anywhere from thirty-eight to fifty parts.

The next item observed was the field X-ray unit of the Picker X-Ray Corporation of New York. This device, which plays an important role in the medical units on the front, uses plastics in many sections. For instance the high voltage lead-in socket uses a low-loss phenolic in one portion of the socket, and a fabric-base high impact resistance phenolic in another part of the socket. This socket carries current and also serves as a rigid mounting for the tube insert. It withstands a pressure test of fifteen pounds psi. The cathode end of the X-ray tube insert has a fabric base supporting bracket that is shock resistant. A transparent phenolic is used in the X-ray part, that is, that part of the tube through which the ray passes. The filler ring, which is substituted for a bracket when the tube is mounted with a central support casting, uses a phenolic cast resin. Other plastic sections on this X-ray are the scale housing, temperature indicating button, port and cone supporting block, knob, etc. The scale housing uses polystyrene; the indicating button, urea molding material.

Aircraft mock-ups are now featuring transparent plastics, which have replaced metal castings. At the Glenn L. Martin plant mock-ups have plastic fuel selector valves, turret control valves, variable volume pumps, and fuel line sections.

Although these plastics are now being used in an experimental way, it is entirely possible that they will be incorporated as standard equipment in aircraft of the future. The display of these complicated parts will eliminate many inspection steps and also permit more thorough and accurate checks, according to Glenn L. Martin.

In one instance, in the deck turret hydraulic control, a plastic housing has taken the place of an aluminum alloy casting that had a tensile strength of thirty-five to forty thousand pounds psi. Although the transparent plastic used had a much lower tensile strength, increase in the wall thickness not only provided a withstanding of this tremendous pressure, but decreased the total weight. The plastics used in the selector valve housing has a tensile strength of six- to nine-thousand pounds psi.

Patents

To Herbert Weil, Jr., of New York has gone patent 2,345,719 covering a foldable plastic picture frame. It has been assigned to the Cellomat Corporation, New York. The patented frame consists of a pair of hingedly related picture frame sections, with each section made of a one-piece plastic picture encasing frame member. The hinged piece of each section is interlockable with a hinged pintle of the mating section, producing a double hinge connection for the two sections.

DuPont has been assigned Raphael P. Coffman's patent 2,345,917 on injection molding of plastics. In this process an injection molding machine is used. This machine contains a heating cylinder from which heated plastic to be injected into a mold is forced. Mr. Coffman lives at Arlington, N. J.

Patent 2,347,697, covering molded material, has been awarded

(*Continued on page* 95)

64 DIFFERENT APPLICATIONS IN

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Fireproof Upholstery Made from Synthetic Resin

Mandatory on New Navy Ships, This Safety Fabric Offers Many Post-War Applications

NEW plastic fireproof upholstery developed by the United States Rubber Company for the Navy to provide an added safety measure on combat ships should prove a great boon in the post-war world. Insurance statistics show that cigarette burns in furniture represent a loss of millions yearly. This plastic lining and seat covering will be available for the first time in peace years, and should abolish the ever present fear of fire to the owners of night clubs, theatres, civilian airplanes, passenger ships, buses, and, of course, hotels where even small smoldering burns amount to a great loss each year.

The upholstery covering now used on furniture of all new Navy combat ships is non-smoldering, gasoline and oil-resistant and extremely durable under wide temperature ranges.

Before the fireproof upholstery was submitted to the Bureau of Ships, the company subjected the material to many rigid tests. In the fire test the material was suspended for 12 seconds in the flame of a Bunsen gas burner. After removal, it burned less than two seconds.

To prove its resistance to high temperature, it was exposed for three hours at 180° F. without becoming soft and tacky. To prove its resistance to low temperature, it was subjected to a temperature of –40° F without cracking when sharply creased. After exposure to oil for an hour, it showed no permeation of the fluid or any other ill effect. After exposure to gasoline for a minute, it showed no permeation of the fluid or other ill effect.

In a flexibility test, it was subjected to 2,000 double flexes in a Navy flexing machine—the minimum Navy requirement—and flexed in alternate directions at a speed of 86 flexes a minute without showing any signs of cracking or separation of the coating from the base fabric. It will easily flex 200,000 times. In addition, it had to pass other exacting tests to prove its durability, toughness of coating, high abrasive resistance, good aging qualities, resistance to salt water and perspiration oils.

In 1937 the laboratory in United States Rubber Company's Mishawaka, Indiana, plant started intensive work on synthetic resin compounds for coating fabrics. The first commercial production was made in 1940 and production has continued at a greatly increased pace since that time. Extensive work has been carried on to perfect non-fading pigments, permanent heat and flame resistant plasticizers and stabilizers, particularly evaluating new raw materials developed since the outbreak of the war.

While the original samples showed promise for synthetic resins as a coating compound for artificial leather type upholstery, the results then did not compare with the possibilities for many post-war uses due to a considerable extent to the laboratory development work carried on during the past several years and to the experience and actual volume production during this period.

The synthetic resins used are the polymerized vinyl chloride types which were subject to almost the same type of compounding improvements as crude rubber. Everyone remembers the evolution of the art of compounding crude rubber: the tires, mechanical goods and coated fabrics produced thirty years ago in comparison with the quality of rubber products of pre-Pearl Harbor days, even though made of the same basic raw materials—the superiority having been achieved solely through and because of the knowledge gained in compounding and the techniques for applying the compounds to the many base fabrics required for the varied uses. The improvement of vinyl resin compounds that has been made during the past several years is comparable in many respects to the improvements that had been made in rubber, although they were much more rapid because of the pressure of war conditions.

Held in bunsen flame 12 seconds, test piece burns for less than 2 seconds after removal

The basic ingredients of the synthetic resins now being used in coating compounds are lime, coke and salt. This resin is then combined with permanent plasticizers and compounded in such a way as to make possible excellent anchorage of the coating compound to the base fabric. In the case of the flameproof upholstery that is now being produced in substantial quantities for the Air Forces, the

(*Continued on page 99*)

Rivets In Plastics Form

(*Continued from page* 43)

Primarily developed for the attachment of fabric to airfoil surfaces in aircraft work, subsequent investigation indicated many other uses for plastics rivets. Upholstery work, either in airplane cabins or in any application where upholstery is applied, could benefit greatly by use of this new rivet. Ease of installation and light weight along with the decorative value of multi-colored plastic is important in this conjunction. Any other attachment process wherein ease of assembly and decorative values are important would be equally benefited.

Development of the plastics rivet is an interesting story of persistent thought and careful selection of suitable material. Due to the revolutionary processes involved and the varied characteristics of the many available plastic materials, there was no definite starting point. A good deal of speculation preceded the initial experiments.

Three fundamental characteristics of the plastic to be used were necessary. The plastics rivet would have to exhibit satisfactory impact and tensile strength, must soften at temperatures low enough to permit handling without special equipment, and should have a coefficient of expansion low enough to prevent loosening of the rivet in the hole upon cooling. In addition, the plastic must be resistant to oil, gasoline, solvents, and other chemicals common in aircraft operation, and must, of course, possess a softening point of a sufficient high range that temperatures ordinarily met under service conditions will not impair their usefulness or practicability.

Rivets used during the initial stage of development were laboriously machined and center-bored by hand. Many were ruined until the correct softening temperature and correct air pressure for clinching had been established. Such factors had to be determined before actual development work was begun.

With airfoil fabric attachment the possible objective, together with need for a more satisfactory method of attaching fabric or plastics interior linings in transport aircraft, initial experiments were made with test structures simulating conditions likely to be encountered to ascertain if such a method of fastening could be proven rugged enough for this purpose. Each test structure was constructed in the form of an air-tight box so that internal air pressure could be used to blow the fabric away from the ribs. This would determine whether the rivet or fabric was stronger, and by careful installation of the plastics rivets, would give some indication as to the aerodynamical efficiency of airfoil surfaces attached in this manner.

Several types of plastics were used in making the first rivets. Preliminary investigation eliminated some types and indicated favorable characteristics of others. Among the plastics investigated were Acrylic, high temperature Acrylic (Lucite HM-119), Ethocel LT, Ethocel ER, Cellulose Acetate Butyrate 204A-H2, 204A-H3, 204A-H4, 205A-H2, 205A-H3, and 205A-H4. Acrylic rivets developed very satisfactory tensile strength, were easy to install, and gave uniform results. Furthermore, the acrylic plastics are noted for their "plastic memory" and this characteristic is very desirable in plastics rivet design. "Plastic memory" is the ability of formed plastic to regain its original shape upon subsequent heating. This factor is a material aid during disassembly or removal of defective rivets. Application of heat will cause the expanded end of the rivet to shrink to original size, and the rivet may be removed from the mounting hole without breaking and put back as desired.

The principal disadvantage of some plastics tested was

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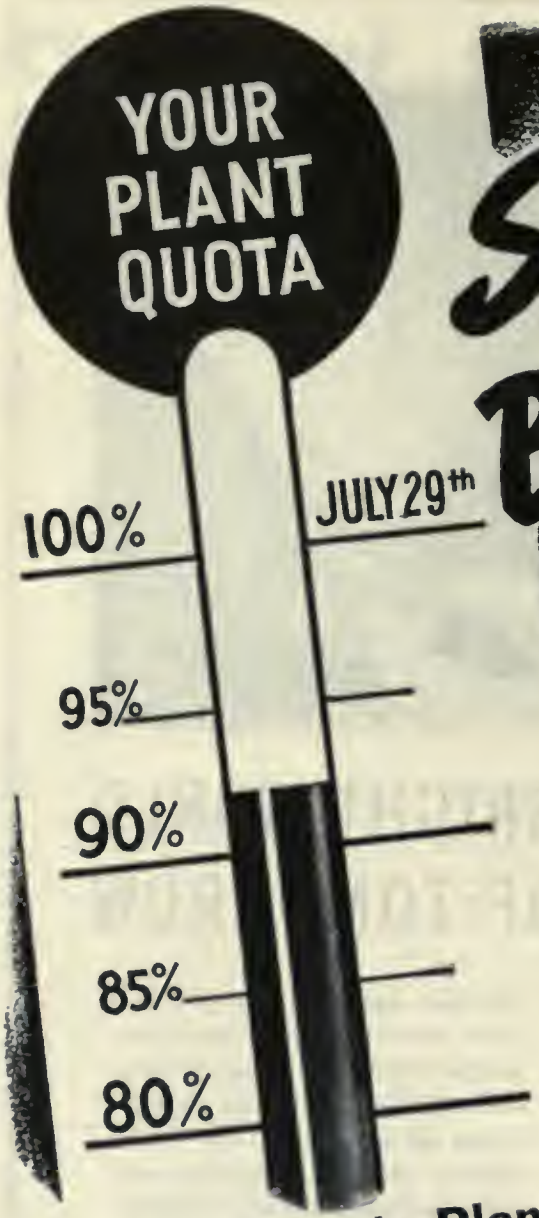

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a tendency to "cold flow" while under tensile strain. Instead of breaking, the expanded end of the rivet would compress and allow it to slip out of the mounting hole. This tendency was very marked with certain plastics formulations. The cellulose acetate-butyrate rivets would break under tensile strain, but not before considerable cold flow had occurred.

The above results are no criterion that methyl methacrylate plastics should be chosen exclusively for plastics rivet fabrication. During development, emphasis was placed on rivet design and installation rather than on evolving a plastics formula of optimum efficiency. A slight modification of many current plastics formulas would probably make them ideally suited for plastics rivet fabrication.

The most surprising characteristic of plastics rivets was the strength exhibited after installation. In the mock-up test installations previously mentioned, tough airplane fabric was riveted to a trussed aluminum rib using center-bored ¼" acrylic rivets. When air pressure was applied to the interior of the mock-up, failure was in the fabric. Calculations showed that a load of 49.3 lbs. had accumulated on each rivet before the fabric failed. Subsequent tests with the rivet installed in a tensile jig gave an average breaking strain of 220 lbs.

A recently developed process for electroplating plastic lends even more promise to plastics rivet development and use. Rivets were submitted for plating, and test installations were conducted. The electroplated plastic develops greater tensile strength, flexural strength, and dimensional stability than the unplated variety. The plated rivets can be driven just as successfully as the unplated type. Crazing of the plated deposit occurs on the expanded end, but all visible portions of the rivet are entirely unaffected by the driving process.

Though developed as a war-time expedient, adaptation of the plastics rivets to civilian goods production offers multiple opportunities. Large plastics companies have already evinced sharp interest in the rivets, and are developing plastics formulas and machines for extruding the rivets in mass production quantities.

The ease with which plastics rivets are installed, along with their strength and decorative possibilities, will make them especially desirable for upholstery work. Upholstery tacks continually loosen, or bend and break. Once installed, plastics rivets are exceedingly durable, and due to the "clinch" produced by the expanded end are drawn up tight.

Light transmission by transparent type rivets of the acrylic type offers extreme possibilities for decorative purposes. Back bars, wall panels, booths, etc., in night clubs or cocktail lounges, equipped with installations held in place by transparent plastics rivets could be rear lighted by concealed illumination.

The industrial applications of plastics rivets are also limitless. Riveting plastic to fabric, rubber to plastic, or plastic to metal are a few illustrate possibilities. Low cost, ease of installation, and the fact that the rivets may be installed when only the head is available during clinching are factors that will contribute substantially to their use.

The most pessimistic observer must recognize that plastics will play an important role in post-war industry. Seemingly fantastic developments of today will be commonplace tomorrow. Certain fantasy has entered into the development of plastics rivets, such as plastics rivets reinforced by steel wire much as concrete is reinforced by steel rod. Rivets in this category, though much lighter in weight, develop strength characteristics to offer possibilities as fasteners for lightly loaded structures. Countersunk flush-type reinforced plastics rivets for fabricating Duramold plywood aircraft are definitely in the picture where cementing is not desirable.

END

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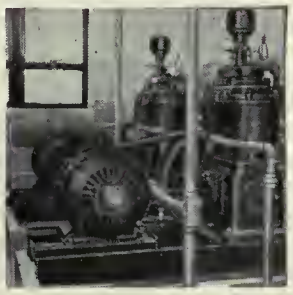

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Premium Goods

(*Continued from page* 14)

toward the increased use of plastics as component parts of other products.

In discussing the post-war use of plastics as premiums it was emphasized that attractiveness of design, pattern and coloring, as reflecting modern trends, was vitally important, for eye-appeal plays a dominant part in determining whether a premium item will be successful or not, as the great majority of those taking advantage of premium offers are women and desire of possession must be aroused on sight.

What can the plastics industry look forward to in sales volume in this premium field?

If the figure of $25,000,000 in sales before the war is approximately correct—and some of the officials of one of the leaders in the industry feel the figure is conservative—then with all that plastics have done, are doing, and will do, by the time the war is over, a mark of $50,000,000 a year should be the reasonable target at which the industry should shoot.

There is a responsibility and a duty attached to the outreach for such a market, that if disregarded will react disastrously against both the plastics industry and the premium users and their products. There must be satisfying quality and suitability of the plastics material for the use intended, coupled with conscientious workmanship and a faithful adherence to specifications that can only come when the business is booked on a quality basis, the same as any other work, rather than on a cutthroat competitive basis.

Disregard of these can only result in disaster to all concerned; the premium is unsatisfactory, the premium user and his product are condemned, and the plastics industry has received a black eye. To a great extent, the future of the industry is in the hands of its molders. It is because there have been wrecks of premium plastics due primarily to booking business on a basis that ignored a legitimate profit and then trying to get by, that this warning is given.

Of course there's going to be competition. The glass, aluminum, pottery, and metals industries are not going to sit idly by and see the molders swarm over into their patch and start picking without putting up a fight. But that's no excuse for booking business that cannot yield a profit. What's more, it isn't, and won't be, necessary unless the molder is trying to commit business suicide.

Premium sales may be divided into two classes: (1) The sale of standard items such as tumblers, scoops, measuring spoons, containers for salt, pepper and spices, cups and saucers, toys, jewelry and novelty items for which stock molds are on hand. (2) The large quantity production of special order items, usually created exclusively for the particular customer, at least for the duration of his campaign.

Advertising agencies have been so generally won over to the use of premiums that many of the large premium orders have come through them, and their assistance in the working out of design, pattern and all the other details leading up to the order has proven most valuable.

"Self-liquidating" offers will probably be much in demand, where the item is offered for so much money and a box top or other evidence of product purchase. If such an offer does not top a quarter of a million pieces it is considered a flop. Many look for from half to over a million returns.

As a rule these premiums are not concurrently on sale at retail. Where a molder has created some special item, the premium field should be exhausted first before turning to retail sales. A premium use of an item aids later retail sales because it has been widely advertised and has public acceptance. Many a good item has been turned down as a premium because it has been sold at retail at a price that prevented a "self-liquidating" offer, so it is a good rule to try for the big game first. END

Life-Like Artificial Eyes

(*Continued from page* 59)

scleral (or white) portion with the iris, and fixing the iris button in place.

Most of the stock glass eyes in this country were made in Germany, and also, most of the glass used in making new eyes came from the same source. The war has cut off supplies of both eyes and materials and consequently, at present, the supply is low. However, the present scarcity of glass eyes is the least of their disadvantages.

The most obvious fault of the glass eye is its fragility. This is an especially dangerous fault if the eye is to be worn by a child. In addition to the exceedingly active life of the average child, he is liable to regard his artificial eye as a very attractive plaything. Not only is it sensitive to shocks but it often cracks or explodes when subjected to rapid temperature changes; in fact, it sometimes cracks merely on standing due to the strains set up in the glass during its manufacture.

A fault not so well known is its lack of durability. Its surface is etched, and therefore roughened, by contact with the fluids of the eye socket. This usually makes the eye too irritating for use after a period of six months to two years, depending on the sensitivity of the wearer and the chemical nature of his eye socket fluid. Other causes of irritation are chipping or flaking of the glass. The latter is an extreme case of etching which results in a powder-like surface.

The etching of the glass surface results in its staining and darkening. During the first month or two of use, this is actually an advantage as it reduces the unnatural glare of the glass surface. However, further use invariably results in too much darkening and streaking.

Once a glass eye has been made, nothing can be done to alter its shape. This necessitates more new fittings by the wearer as his socket changes, especially during the few years following the removal of his natural eye. It also requires the dealer to stock a much larger variety.

Finally, the most serious disadvantage of the glass eye is its appearance. First, there is the staining and flaking already mentioned and the unnatural glare and brightness of the glass. The iris pattern, with its fine lines radiating from the pupil, does not come close to rivaling the human eye in its complexity; there is always detectible a slight twist or spiral arrangements of the radiating lines. The pupil, made by placing a small piece of black glass on top of the iris colors, seems to float above them.

The Mono-Plastic eye overcomes all of these disadvantages. All the materials for its manufacture are made in this country, thus relieving us of dependence on Germany for present or future supplies.

It is true that the Mono-Plastic eye may be broken with a hammer, but all attempts to break it by dropping it on a hard floor surface from heights as great as fifteen feet have failed. Owing to its plastic construction, it is impervious to the effects of heat, cold, and moisture, and has no tendency to crack or explode.

The methacrylate surface is non-irritating to human tissues as has been demonstrated by its use in implants at the Mayo Clinic. Methacrylate surfaces, after two years of use (in the plastic-glass combination) have completely failed to show any tendency to flake, etch or stain. The last three faults, should they crop up when the eye is subjected to longer use, could be easily remedied by the simple and inexpensive operation of repolishing.

The methacrylate shape is perfectly adaptable. It may be built up or ground down at will. Thus, it may be made to follow the changes which invariably occur in the empty human eye socket.

The plastic eye does not reflect as much light from its outer surface as does glass. Out of the socket, it does not look "glassy" and, in the socket, it is more soft and natural. The iris pattern of the Mono-Plastic eye lacks the "twist" associated with the glass iris and has the appearance of a color photographic duplication of the human eye in all its complexity. The pupil has been given the appearance of a hole in the center of the iris and does not appear to be a superimposed black dot.

The plastic eye suffers from two disadvantages. It is scratched a little more easily than glass. The scratches, which could result only from careless handling, can be easily and cheaply removed by repolishing. It is sensitive to organic solvents such as chloroform and acetone, and to alcohol except on immersion for a short period of time. It is relatively insensitive to volatile petroleum solvents.

The Mono-Plastic Eye Company in Evanston, Illinois, consists of a very modernly equipped laboratory, complete facilities for the preparation and fitting of made to order eyes, and an elaborate set-up for human eye photography.

The importance of an all plastic eye for the armed forces is obvious. A member of the armed forces, even though he may not be on actual combat duty, has too heavy a responsibility to be subjected to the danger of breakage of a glass eye. In addition, many new eye casualties are to be expected and they will perhaps cause an unbearable drain on the now depleted stock of glass eyes.

With the realization of these facts, Mr. Jardon and Dr. Bennett very recently went to Washington, D. C. and submitted their all plastic eye for inspection by the Office of the Surgeon General, the Navy Department, and the Veteran's Administration. All three were pleased with the eye and requested that more samples be submitted for testing. At present the Mono-Plastic Eye Company is making every effort to place itself in a position to supply the armed forces, should it be called upon. —END

MEXICO'S RAW MATERIALS

Mexico City (UTPS)—Mexico's natural wealth of raw materials for production of plastics will assure her a front-line rank in the economy of the post-war period, Francisco Javier Gaxiola, Jr., the Mexican Minister of Natural Economy, told 700 delegates from American republics who attended the recent Congress of Chemists in Mexico City.

Mexico's place in the coming world of plastics, the minister brought out, will be largely determined by two factors: (1) The high cost of industrial equipment, which will be a serious handicap to local, large-scale production; and (2) Mexico's possession of an abundance of the raw materials for the manufacture of plastics. But taking both these elements into consideration, he concluded that "without the disadvantage of having to organize ourselves industrially, we will be in a position—provided that we apply scientific methods to the utilization of our raw materials—to take our place in what can well be termed a new order of commerce."

One of the three United States representatives at the conference, Dr. Horace C. Porter, likewise predicted that plastics will help to solve many of Mexico's problems. END

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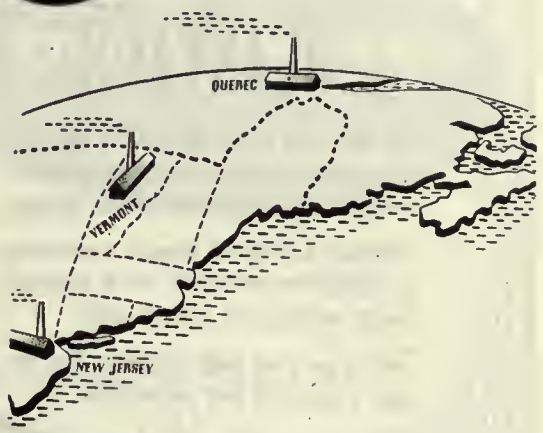

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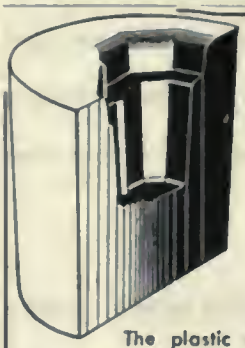

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(*Continued from page 34*)

any adverse effect on the gluing and finishing characteristics of the wood. Flame resistance is improved and the wood is also more resistant to fungi, rot and pest infestation.

The process appears applicable to the sapwoods and heartwoods of a large variety of species. Sapwoods impregnate easier than heartwoods. The heartwood of most hardwoods is more readily impregnated than the heartwood of some softwoods.

The resin formed in the wood has no odor, is not toxic, is not affected by organic solvents or water, and does not affect the color of the wood. The resistance to the action of most chemical agents is markedly improved.

It is also possible to impregnate sawdust, shavings or similar wood wastes and form them under heat and pressure into molded objects. The process is also applicable to other cellulosic and fibrous products such as paper, cotton, farm wastes, leather, and the like. Bamboo and similar cane and fiber products can be treated.

Partial Impregnation Possible

Emphasis has been given to the complete impregnation of wood to obtain the maximum freedom from dimensional changes. There are, however, conditions where complete impregnation is not necessary, desirable or economically feasible and where a shallow or perhaps even a surface treatment may contribute the necessary improvements. The complete impregnation of wood, while increasing the compressive, tensile and bending strength, tends to lower the impact strength for resistance to shock. That is, it becomes more brittle, just as hardened steel is usually more brittle than soft steel.

As it is often desirable to case-harden steel, leaving a softer tougher core to withstand impact, so there are some instances where wood members may be given a treatment to harden and strengthen the outer zone, leaving the untreated inner fibers in a more resilient flexible state to withstand impact stresses.

Timbers, and wood members required for the construction of trestles, towers, homes, various buildings, boats, airplanes and the like may be improved by a hardened, high strength shell. This would allow the wood to take much higher loads or allow the use of lighter construction. The treatment of the outer zone would also contribute improved dimensional stability, flame resistance and resistance to decay and insect infestation. Similar treatment could be applied to the production of hard-surfaced flooring and improving the dent and mar resistance of furniture and paneling.

Costs

The cost of the chemicals, operation charges, and investment in equipment are moderate. In many instances the cost of treatment may be more than balanced by the resulting advantages and economies. Some of these are:

1. When veneer, which is valued on its surface area, is treated, it remains close to its green dimension, representing a gain of 5 to 10% in area over untreated veneer.
2. Due to greater strength and stiffness, lighter construction or less wood is required for certain items.
3. Low cost, readily available woods can be treated and made competitive to higher priced scarcer woods that may have the added cost of transportation from far places.

4. Wood may be used for purposes for which it is now not suitable, in direct competition with the far more expensive plastics and metals.
5. Finishes and colors can be produced directly on wood by pressing, eliminating such expensive and time-consuming operations as filling, sanding, staining, rubbing, varnishing, and polishing.
6. Furniture, drawers, doors, and the like can be made to fit and operate freely under varying atmospheric conditions, resulting in economies in production as well as in servicing.
7. Since the finish produced is "built-in", surfaces that are scratched or dented can be readily restored by smoothing and rubbing, requiring no matching, filling, varnishing or refinishing.
8. Certain manufactured items can be compressed to final size, thus eliminating machining costs and at the same time applying a surface finish. This may be applicable to flooring, table and desk tops and other furniture, machine parts, rules, levels and the like.
9. Increased durability or resistance to water, chemicals and solvents means longer life and less replacement for such items as laundry and chemical plant equipment, wood tanks, window, screen and door sash, and machine parts.
10. In production of plywood or laminated veneer construction, the treated wood is self-bonding, eliminating the need for other adhesives.

The direct costs depend on a number of factors such as the scale of operation. The cost of chemicals varies with the amount used, which in turn depends on the type of lumber treated and whether it is fully or partially impregnated. Commercial woods grown in the United States vary in weight from about 24 to 47 pounds per cubic foot. Exclusive of timbers, structural parts, and other items which would only be surface or case-impregnated, the application of chemical varies from 10 to 30% of the dry weight of the wood. Thus, one may require from 2.5 to 14 pounds per cubic foot of wood. For average requirements, applications of 15 to 20% would suffice. This represents a dosage of about 5 to 6 pounds of methylolurea for the average wood weighing about 30 pounds per cubic foot.

The present cost of the chemicals is 8 to 9 cents per pound at the mill in small quantities. Thus, the cost of chemicals for the complete impregnation is of the order of 3½ to 4½ cents per board foot of lumber. For the average veneer, the cost is about 0.15 cents per square foot. In the "case-hardening" treatment, the cost would be from 0.3 to 2 cents per board foot.

Investigations on production, procedures, properties and applications of methylolurea treated wood are in progress. The process is just emerging from small scale tests towards industrial evalution and adaptation. The general procedure and limiting conditions have been established. The exact conditions for more effective treatment of specific items will necessarily have to be determined through plant tests and experience. END

NYLON HAMMOCKS

Jungle fighters are to sleep in nylon hammocks the U. S. Army Quartermaster Corps has announced. Nylon has been adopted because of its greater durability, lighter weight and freedom from mildewing as compared to the cotton hammocks now in use.

For the present the hammocks will be used only where the mosquito problem is most acute as present procurement limitations cut down the available supply.

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Acetate Sheeting

(*Continued from page 50*)

aerial photographs are used to make more accurate maps of little known regions, such as sections of Canada or Africa, which are only blank spaces on many charts still in use. Photogrammetry makes it possible to include such guiding land characteristics as mountains and streams in wild places, where only a few men have ever set foot.

Lines of metal templets trace course of aerial photographers to fix landmarks

The photogrammetry process begins in a high-speed airplane, equipped with cameras that have wide-angle lenses, arranged to make photographs by an automatic trimetric projection method. The shutters click simultaneously. They make three photographs at once of the ground below, one vertical with two matching obliques. Three such pictures are taken every three miles. One charting plane, following a planned course, can photograph about 12,000 square miles of territory every three hours.

The photographs are sent to photogrammetry plants, in St. Louis and elsewhere. They are studied and matched carefully so that a series of them fits into one continuous picture of a section of terrain. This is studied under magnifying glasses, and the outstanding landscape features are marked in red and blue ink.

Stability of Huge Areas

This is where plastics enter the picture. A sheet of cellulose acetate, sometimes as large as 50 feet square, is laid down. (Such a wide area of acetate is attained by using 40-inch-wide strips, held together with transparent Scotch tape.)

Lines of metal templets are then laid over the acetate, with each line indicating the course of the photographing plane's flight. The intersecting templet arms locate the prominent landmarks which had been marked previously on the photographs. These detail points are traced on the acetate in their true position, conforming to scale.

Throughout the templet process, the chart makers crawl over the acetate to make their markings, an ordeal that sometimes requires a week or more. It would stretch or tear a material less hardy.

The acetate is then cut into sections. Sections of it are matched with the actual photographs, from which the markings were traced. Then landmarks are traced upon the acetate by means of a "sketchmaster." This unique device projects the image of the original photograph upon the acetate base, allowing the sketcher to follow the lines of rivers, hills and the like from the photograph in true scale.

These drawings are done in pencil. After that, the acetate is rejoined with tape and the drawings are inked in.

After editing and correcting, the acetate is again cut up and sent to the photographic department, where the sketches are reduced to scale by the photographic process.

The reductions go to a department equipped with vertical reflecting projectors. These machines project over old charts the new ground features that the camera has caught, and photogrammetry, by aid of plastics, has captured. The new features are drawn in over the old map, making a more complete and more accurate one.

The important thing in the photogrammetry process, so far as plastics are concerned, is that the acetate is subjected to countless contacts with sweaty hands and scraping of feet, let alone several cuttings, rejoinings and manhandlings that normally occur during the tedious process of making a map or chart.

Major R. O. Davis, in charge of the Photogrammetry Section of the Aeronautical Chart Plant in St. Louis, says that he can visualize no other material that could be used in the process and stand such punishment.

"Acetate has become so important in making aerial charts that I cannot comprehend what the process would be like without this plastic material," he said.

"We use it because acetate is a very strong medium. It is easy to handle. We roll it, cut it, rejoin it, and the acetate doesn't suffer. Dirt does not grind into it. Dirt can be washed off easily.

"Acetate expands and contracts very little. And what expansion and contraction it does, occurs in equal proportions, horizontally and vertically. If we make an error over a large section of acetate, the error can be mopped off, and no one can tell the difference. There is no roughing up, as would be the case with an erasure on paper."

"Overprinting" Uses

The photographic department of the St. Louis plant where the work on acetate of the photogrammetry department is reduced to scale, uses film with an acetate base. In one week this department has used some 6,500 feet of film—more than a mile. Its particular acetate base has been found to give the film stability; to prevent it from reacting to hot and cold.

After the new information, gathered through photogrammetry, has been traced over an old map, the improved map is sent to the drafting room, where plastics again are used to good advantage in "overprinting."

Robert W. Carter, cartographic engineer in charge of the drafting department, estimates that the use of plastics causes a saving of at least 30 per cent in time, and that monetary costs are cut to an even greater percentage.

"Stick-Up" Process Saves Labor

Plastics enter into both its general map making and air-chart overprinting operations through a system known as the "stick-up" process in the drafting room. A light transparent type of plastic (Il-Luminate or Dura-Seal) is used to increase the efficiency of the drafting process. These plastics have an adhesive backing, and the names and symbols used in chart making are printed on them.

When making a map, the draftsmen have only to look over the printed names on plastic when they wish to designate a name on their map. They cut the name out with a razor blade, and stick it carefully at its proper place. The name "stick-ups" eliminate any need for tedious hand lettering. If an error is made, there is no need for an erasure. The draftsman merely scrapes

ff the "stick-up," and substitutes a new one in its place. The plastic "stick-ups" contain information that goes nto aviation over-prints, such as names and symbols of ll airports in the area being charted as well as various eacons and aviation lights.

The isogonic line, which is an imaginary line connecting points that have equal magnetic variation from rue north or from the compass point, are printed in the orm of a straight, broken line. The draftsmen merely ave to paste these along the true course, rather than draw hem.

Radio ranges are drawn in the shape of elaborate eometric figures. But the draftsmen do not have to raw these—merely paste them in at proper places.

The Air Forces' chart plant in St. Louis is the only ne in the nation that makes these aeronautical overprints. The St. Louis plant not only makes overprints or the maps it manufactures itself, but its principal ob is printing this flying information for maps made by ther Government and commercial agencies.

The entire matter resolves itself into a great dependence pon plastics, which help organize into mass production natters so intricate as maps for aeronautical flying. The Chart Plant in St. Louis has helped to guide thousands f bombers and fighters to their destination, and then ack home.

And the reason such a plant has been able to do so—nade up as it is of relatively unskilled personnel—is lastics, which pick up at some point where human railties begin. Plastics have helped to make housewives and office workers into cartographers, who have elped immeasurably in bringing the bombers back home.

The Army Air Forces' Aeronautical Chart Plant, in St. Louis, with Col. H. Arnold Karo in charge and Maj. W. J. Van Nice as executive officer, is one of those war plants which established a reputation quickly. END

Heat-Resisting Thermoplastic

(*Continued from page 62*)

By reason of poor dimensional stability in general and low heat resistance in particular, thermoplastics have been barred from use in broad fields of application.

High Flexural Strength

Under the stimulus of war needs, two materials have been developed to overcome these handicaps—*Styramic HT* and *Cerex*. While the former is still in the class of military secrets, it is known to be a specialized high cost material of critical importance in super high frequency insulation.

Confined to war applications now, *Cerex* can be used for civilian purposes later on, according to Mr. Belknap, "wherever high heat-resistant qualities are in demand." This includes automobiles and aircraft, buildings and business machines, electrical, optical, and photographic devices, surgical instruments and numerous household uses.

Cerex is a series of copolymers, of which the one known as X214 is receiving most attention at present. Its advantages are not offset by any impairment of mechanical properties, according to the Monsanto report, which continues: "Tests, run on pilot plant material, indicate that flexural strength runs around 13,000 psi.

"Electrical properties of the new material are superior to those of most other thermoplastics although they are not as good as those of polystyrene and *Styramic HT* at very high frequencies.

"The dielectric strength of the material is more than 500 volts per mil. Surface and volume resistivity are also excellent and are not appreciably affected by prolonged

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immersion of the material in water. Maintenance of electrical properties under high humidity conditions is assisted by the low water absorpton. *Cerex* has unusually good resistance to acids. It has been subjected to boiling sulfuric acid without effect, and in a series of prolonged tests, withstood conditions that corroded enameled steel and attacked the surface of aluminum.

"The material now being produced has a transparent amber color. Color possibilities in molding compounds are somewhat limited, although a range of transparent, translucent and opaque colors can be obtained. In flammability tests, the material is rated as slow burning.

Post-War Applications

"War applications of the new material have received exclusive attention in development work. These include electrical applications where moderately low electrical loss properties are required in combination with heat resistance higher than supplied by present thermoplastics. Coil forms, crystal holders and condenser cases are typical of the application being studied. Aircraft battery cases molded of *Cerex* X214 have withstood very severe tests. In one such test the sulfuric acid electrolyte was actually boiled without deformation or chemical attack of the molded case.

"In effect the availability of this new material breaks down the dividing line between the fields of application for injection and compression molded products. The injection molder can now produce parts for service at temperatures that previously have required the use of thermosetting materials. Surgical instruments, sanitary ware, restaurant serving dishes and medicinal packages that must be sterilized by steam or boiling water typify the potential civilian applications. Radio and electronic parts can now be injection molded and yet have resistance to the ambient temperatures encountered in such apparatus.

Molding Procedure

"As mentioned previously, the high heat resistance of molded *Cerex* X214 is not accompanied by the necessity of higher injection molding temperatures. Heat is supplied to the molds by steam or electrical resistance units. The same nozzle and heater arrangements in use for several other resins are suitable, and in general sprue runner and gate require little change for adaptation for the new resin." END

Applications in Cosmetic Field

(*Continued from page* 48)

such ingenious and attractive items as the hair band of spiral plastic, shown in color on page 40.

Hand mirror frames and hairbrushes likewise show the influence of new technique in plastics. The colorful hairbrush appearing in the color photograph on pages 40-41, with handle and back of transparent acrylic, provides an example of modern treatment of plastics for this purpose.

The development of plastic lipstick containers has perhaps been one of the most noteworthy instances of the decorative potentialities of plastics in the cosmetics field. An aspect of great importance in the merchandising of lipsticks of course lies in the case, or container. It must be attractive. Sturdiness, durability, ease of manipulation, and other factors that are part of a good lipstick case must be enhanced and supplemented by eye-appeal. A great variety of beautiful lipstick cases of metal were sold before the war, but with the increased development of plastics a new and stimulating medium for this item came to the fore.

Now that lipstick containers of plastic have to a very great extent replaced the metal containers, their decorative

properties in this connection are constantly becoming more evident. Typical of what can be accomplished along this line is the striking lipstick shown in the accompanying photograph. Made of cellulose acetate, it is fashioned to "resemble a carved ivory treasure piece." The design emphasizes the value of the plastics container as an aid in merchandising display. In black, it resembles carved and polished ebony.

The rouge case, also pictured, provides another example of the "carved," or cameo technique. Cellulose acetates have been used in this item, utilizing the high impact resistance which is characteristic of these materials, as well as their wide range of color selection. The same properties have dictated the extensive use of cellulosic plastics in lipstick containers of the thin-walled variety.

When the growing popularity of "cake makeup" made desirable and necessary a durable and light-weight container for the produet, so that women could carry it in their handbags, plastics provided the logical answer.

Plasties also have proved to be the ideal medium for novelty items such as a small "carryall kit" in which the differently colored plastics sections are threaded to fit into each other. Each section holds, respectively, powder, cold cream, and rouge. Urea formaldehyde molding compounds, as well as the phenol formaldehydes, are used in these kits.

The opportunity for creative ingenuity through the use of plasties in the packaging of cosmetics and toiletries presents unusual scope. For here, design may be not only durable and practical, but may be directed toward the traditional love of beauty which is inherent in women. Women want not only good cosmetics and practical containers for them, as well, but they want colorful items which blend with their costumes or adorn their dressing tables. END

Engineering News Letter

(*Continued from page* 83)

to Constance D. Levey, New Orleans, La. The patented material is composed of a highly compacted mixture of powdered bagasse having less than 10% of moisture, and powdered gilsonite. There are in the mixture one to two parts of gilsonite to four parts by weight of bagasse.

A method of embossing crystalline polymeric material served as the basis of patent 2,345,629, awarded to John H. Reilly, Midland, Mich., and assigned to the Dow Chemical Company. An embossing die at a temperature above about 50°C is impressed upon a supercooled body in this system. The crystalline polymer consists of polymeric vinylidene chloride.

A process of rendering a methaerylic resin substantially free of elastic properties which cause deformation when shaped artieles of this material are heated, was the basis of patent 2,346,107, awarded to William S. Johnson, Philadelphia, Pa., and assigned to Rohm & Haas Company.

A method of pulverizing resinous and thermoplastic materials appears in the patent grant to Charles W. Cuno, Wilmington, Ill., which was assigned to the Lehon Company, Chicago, Ill. The patent, 2,347,464, covers the proeess of mixing a thermoplastic material with solid carbon dioxide to substantially lower the temperature of the material. The solid carbon dioxide is treated by adding a liquefied gas with a temperature below that of a solid carbon dioxide to further lower the temperature of the material. The solid carbon dioxide has the property of absorbing liquefied gas.

An Alien Property Custodian patent, 2,347,036, covering a proeess for the production of filaments from molten thermoplastic materials, was also made available this month. It was originally awarded to Eugen Dumont of Troisdorf, near Cologne, Germany. END

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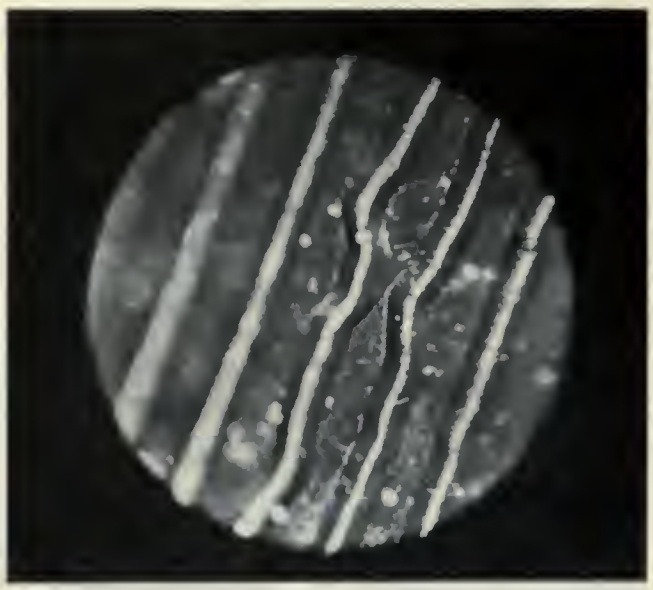
rotton stone (Tripoli) with either ground barytes or blanc fixe.

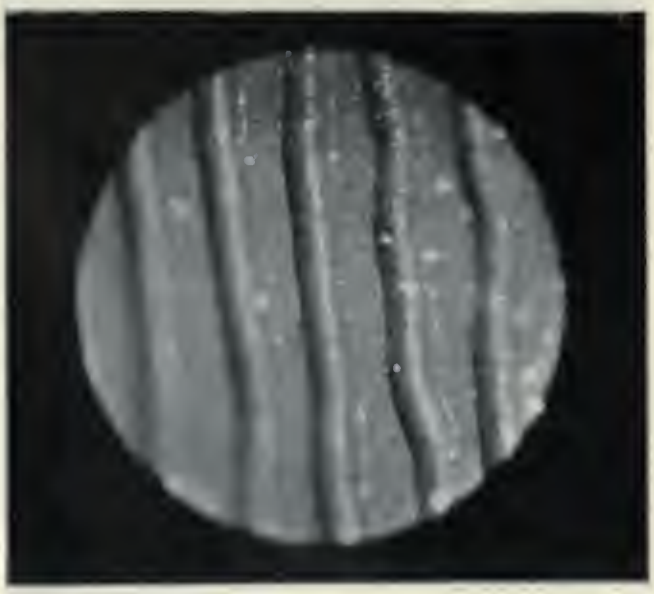
In making up the mix, the chemists state that flock may be used in amounts to about 3% of the total weight of the whole composition. The blacks may vary from 2% to 15% of the whole, depending upon which is used and the color of the mineral filler. The mineral filler ranges from 45% to 75% of the whole, depending upon the kind used, as the mineral fillers vary in weight.

It is also possible to take ground record scrap or flash and add it to this material in any proportion required.

In manufacturing records with this material either standard mill rolls or the regular Banbury mixer may be used. The composition is ground for a short time with the heat at about 300°F, until all lumps and unmixed material have been evened out. Then the hot plastic is transferred to a calendering drawing machine where it is formed into a long sheet while still hot. Rotating knives cut out small rectangles. Then the material is allowed to cool and the small rectangular pieces are broken up into "biscuits".



Photomicrograph above shows the grooves of a phonograph record made entirely from the substitute Luckite. The grooves of a record made in whole from pure shellac are shown in view below



Steam at about 300°F is used to heat the record molds. The biscuits are pre-heated and balled. The mold is then put into a hydraulic press which exerts about 2000 psi of record area.

Like shellac, Luckite can be worked and milled and molded over again. Its flash, according to the Luckite chemists, can also be used with the flash of pure shellac records.

Coatings

Another material which appeared as a shellac substitute is zein, a thermoplastic derived from the protein of corn. It sells at about 25c per lb. The softening point of zein is 375°F. However, the softening point is reduced usually through the addition of a solvent type plasticizer or a solid solvent such as rosin.

Solutions of zein and ordinary gum or wood rosin in alcohol have been widely used in replacing industrial shellac coatings. Normally such solutions contain approximately equal parts of zein and rosin, although laboratory studies have indicated maximum film hardness in a composition of 25% zein and 75% rosin. A 50-50 zein-rosin film begins to soften at 126°C and is freely flowing for molding at 142°C; a film containing 25% zein and 75% rosin begins to soften at 111°C, and is freely soft at 130°C.

Greatest difficulty in the application of zein-rosin compositions as substitutes for shellac has been their tendency to gel in storage. However, a recent analysis indicates it is possible to retard gelling by pressure cooking at 120°C in the presence of formaldehyde. According to the zein chemists, one procedure which has contributed considerably to the commercial value of zein-rosin mixtures involves a pre-treatment of the zein and rosin in a molten state. If the correct plasticizers are added, zein films can be applied to flexible materials such as paper.

Commercial Output

Formaldehyde can be used to cure zein films and compositions, such curing usually increasing the film's hardness and water resistance. However, the chemically inert nature of the zein molecule will cause a much slower curing action than is the case with other proteins. As a rule, about 40% formaldehyde is used for each 100 parts of zein.

Record companies have made satisfactory recordings with these materials and several are planning to produce records with these substitutes on a commercial scale soon. However, the recent lifting of some restrictions in shellac allocation order, prompted by the increased imports of shellac, might slow down the projected substitute production schedules. But, it is not expected that plans to make records from substitutes will be curtailed completely, particularly since chemists say that these substitutes are capable of providing records of improved qualities and as economically as the shellac type records. Thus, in effect, the substitute type records will complement the shellac type records. Like shellac, these substitutes have other than phonograph record uses.

Shellac has been an ideal material for insulation, especially when combined with flaked mica and asbestos. It also is used as an important agent in cements, preservatives and photographic supplies. In spirit varnishes, shellac has also been found to be invaluable. Here, many replacements such as Zinlac have been developed, and the trade is now reported to be selling more of the substitutes than it ever did of shellac varnish. END

Boat Hulls from Wood and Resin
(*Continued from page* 31)

an impregnating phenolic resin. The veneer cells take up approximately 30% of resin solids.

Impregnation gives the surface ply greater hardness, resistance to abrasion and improved dimensional stability. Both the bonding and impregnating resins are polymerized in one autoclave cycle.

When the veneers have been wrapped on the mandrel the assembly is enclosed in a cellophane envelope which acts as a parting agent and then covered with a neoprene fabric bag. The bagged assembly, weighing about 3000 lbs, is then wheeled into the autoclave for processing. The curing cycle is 45 minutes at 300° F.

The finished hull is the product of 1600 net sq ft of veneers and 6 gal of resin. On a comparative weight basis there are 215 lbs of wood and 30 lbs of plastic.

Successful plywood molding requires exceptional attention to many details. Veneers must be of first quality, resin spread cannot be thin, wrapping must be tight, bags leak-proof and the heating of the autoclave carefully regulated.

The Army's boat is doing yeoman service in arctic and tropical waters. Fully equipped, it weighs 1800 lbs, and powered with a 57-horse motor it even does tug boat duty. Mainly it is used for moving pontoon or float sections and parts for the assembly of floating bridges.

Post-war molded plastic bonded hulls should have a powerful influence on boat design. United States Plywood Corporation believes hulls up to 24 ft in length will be molded, probably in two halves now that the so-called cold-setting phenolics are proving so effective for assembly gluing.

Those who imagine the autoclave plywood molding technique producing bathtubs, refrigerators and kindred articles are likely to be disappointed. While the process makes the forming of large units at low pressure practical, the production rate is slow and costs are likely to be too high for the making of high-volume, low-cost articles.

Combination Constructions

Perhaps the most promising future for molded plywood is in the field of pipe and tubing. Currently United States Plywood Corporation is producing its Weldwood tubing at the rate of 8 miles per week in diameters from 3″ to 8″ O.D., wall thicknesses ranging from ⅛″ to 1″.

Plywood tubing is exceptionally light and of great strength. Its principal war use is in radio antenna masts, some of which are 90 ft high. Post-war plywood tubing should find a score of uses in industry, for piping fluids or dry chemicals and for such structural applications as call for the combined strength and resilience of wood.

The close cooperation of plywood manufacturers with the plastics industry is likely to result in combination constructions employing veneer and high-strength impregnated paper. A substantial number of molded articles combining veneer and paper have been produced commercially. Other possibilities are to be found in the combinations of veneers and impregnated fabric or impregnated glass cloth.

The autoclave process is ideally suited to combination constructions, and many interesting developments may be expected.

Although plywood molding has been the subject of much fantastic overstatement, the excellent performance of the Army boat may be regarded as proof that plastics do permanently weld veneers together. END

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Plastics in the Modern Home
(Continued from page 22)

num and magnesium, as preferred metals, while corrosion resistance in cooking utensils requires stainless steel or aluminum. Important also are the different finishing techniques possible, allowing steel when provided with a coat of vitreous enamel, to compete with stainless steel and aluminum. Again that is a problem in maximum performance at minimum cost.

The ultimate consumer is amazingly realistic in balancing the expected performance against the prices charged. The reasoning of most housewives in the selection of a kitchen utensil made from stainless steel, chrome plated copper, aluminum or enameled steel would benefit many an engineer. Inter-group competition, such as plywood against aluminum in the airplane, glass against stainless steel or aluminum in kitchen ware, and enameled cast iron against ceramics in wash bowls, places plastics in competition with any and all of these materials.

Plastics provide a great many desirable characteristics: light weight, permanent deep colors, chemical inertness, absence of maintenance, pleasant feel, and electrical and heat-insulating characteristics. They are chip-proof and allow beautiful lines and complex design.

To examine the influence of all the prior considerations on the design of some typical units of home equipment, let us begin with a most important unit in the range of appliances for the modern home, the refrigerator.

The function of this unit makes a heat-insulating character highly desirable for the materials used in its construction. A permanent, sanitary finish is also highly important. Good structural strength and good behavior in rugged handling is quite necessary and low cost is of the utmost importance both in detail parts and assembly-procedure required, the industry being a highly competitive one.

Structural plastics fill this combination of requirements better than the other structural materials. The metals are heat conductors, the wood derivatives are not sufficiently permanent and the mineral materials are not sufficiently tough.

If we can design our plastic units to meet the cost of the present construction, the structural plastics refrigerator will be a familiar sight in the post-war period. Many of the present designs already incorporate structural plastics in one form or another. Refer especially to the laminated paper base inner door liners and the laminated paper base breaker strips. Although capable of improvements, they have proved to be highly efficient.

The outer door, especially where complex curvatures and recessed design are required, is a natural for pulp-molding. The inner shell, eventually all in one with the breaker strips, is an excellent application for low pressure, paper base laminates, although especially where more curved designs are desired, pulp molding again seems to hold considerable promise. The outer shell is well adapted to paper or cloth-base construction by the post forming process or molded plywood which, however, would limit the design to straight lines.

Pulp molding, in allowing complex and difficult curvatures, gives a freedom in lines which is intensely desired by progressive product designers. A design has now been made of an outer and inner refrigerator shell in one molding to indicate one of many possibilities. We believe that this will be arrived at sooner or later, a better product and an appreciable saving in assembly costs being evident.

On the subject of furniture, the laminated paper base, decorative table tops are highly popular because of their

attractive color and appearance, easy maintenance, excellent resistance to alcohol, fruit acids, alkalies, etc., and their good resistance to high temperatures especially in the so-called cigarette proof materials. Here a thin foil of a highly conductive sheet metal is embedded in the plastics providing sufficient dissipation of heat to prevent local over-heating from a burning cigarette or a hot kitchen utensil. These materials are naturals for dinette table tops, desk tops, dresser tops and drainboards where a separate sink bowl is used. Urea or melamine top veneer provides the properties mentioned in combination with the phenolic resin impregnated structural body.

Chairs of all descriptions form a very fertile field for the application of structural plastics. For some time past, pilot seats for airplanes have been made from cloth base laminates. In this application, structural reliability under the severe strains imposed on the pilot seat in flight is more important than attractive appearance.

However, in post-war designs where appearance and cost will be factors of greater importance, large-unit designs like those illustrated may well prove to be superior to those in other structural materials. They will be low in cost and especially attractive in appearance because they will not show irregular lines at places where the laminations were cut to allow the deep forming.

Many designers have suggested designs that can be very well produced from flat sheet stock by post-forming with either paper, cloth or plywood as a base and where ultra-modern design is no restriction, this type of furniture should find a market.

Finally, there is needed a host of plastics cabinets, housings, etc., for washing machines, sewing machine covers, radio and television consoles, air conditioning housings, vacuum cleaner parts, trays, etc. For these beauty and permanence of plastics and, in many instances, their lower costs will be decided advantages.

Where impact resistance is a factor of outstanding importance, the cotton base laminates will be selected, but when appearance is a prime factor, the decorative paper base laminates and pulp moldings are to be preferred. The paper base materials will take care of relatively simple designs embodying single curvatures and very shallow drafts, while pulp molding will prove its value in the more extravagant complex curved designs. Both provide lower costs than almost any other plastics. They are well able to compete with wood and aluminum, and in certain cases even with steel. END

Fireproof Upholstery

(*Continued from page* 84)

synthetic resin coating compound is securely anchored to a strong, fine count, high twist cotton base fabric under high heat and pressure conditions, and after complete processing it results in an artificial leather that is greatly superior to all previous types of imitation leather known to date.

This type of plastic upholstery, in addition to the qualities proven in the Navy tests explained above, is sunfast and is practically inert insofar as chemical change after aging or "oxidation" is concerned. It has the pliability and softness required for the most exacting upholstering applications, but at the same time has the durability, abrasion and flexing resistance needed for long and satisfactory service.

This type of artificial leather can be made in a great variety of color and grain combinations. END

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Colored Acrylic Windshield

(*Continued from page* 26)

undyed methyl methacrylate. The effect of the colored panel in decreasing atmospheric haze more than overbalances the effect of increasing the haze within the panel itself.

Fig. 3 shows some of the spectral transmission curves obtained by the spectrophotometer. These show, for example, that Sample 5 has more red than Sample 7 because the curve for the former indicates more of the longer wave lengths which are in the red range. On the other hand, Sample 7 has more blue than has Sample 5 since the latter contains more of the blue wave lengths.

A comparison between the values in Figs. 3 and 4 indicates that the dyed panels allow less total light through than does the undyed glass. However, this does not mean that the objects cannot be seen as plainly when looking through the glass. On the contrary, because of the reduction in haze and glare, and the increase in eye sensitivity to yellow-green color, and by the proper selection of color combinations, an increase in visibility can be effected.

After a thorough study of all factors involved, the Research Department at North American chose Samples 5 and 7 as being the most desirable. On the other hand, neither sample is entirely satisfactory and further work is continuing in the hope that a still better product can be obtained.

Method of Manufacture

The material used for the dyed enclosure panels is transparent methyl methacrylate. Two methods may be used for coloring. One is to mix the dye into the uncured liquid before casting, and then heat-cure, making the final hard product. In this way, the color is dispersed throughout the sheet.

The other system is to dip the final cast sheet into the dye solution under definitely controlled conditions. The dye penetrates the surface of the sheet and colors it.

The latter system was developed by the Krieger Color and Chemical Company, and is considered to be a major advancement in the technique of dyeing plastics.

The colored sheet as flat stock is made ready for forming by first removing the paper and thoroughly cleaning it of cement and dirt which might adhere to the surface. It is softened by heating in an oven for several minutes in the conventional manner, and is then placed between male and female plaster dies as shown in Fig. 5. The dies are closed and the part is allowed to cool.

After cooling, the sheet is marked for cutting by means of a template upon which it is placed. It is then cut to its true outside dimensions on the band saw.

The next operation is to decrease the thickness of the edge by routing to approximately 0.040" along the entire periphery of the part and approximately ½" in from the outer edge. This is done so that when installed, the part will mount flush with the framework and therefore cause no additional drag.

The final machining operation is to cut round slots at the edge approximately ¼" in diameter and ½" from the edge toward the center at intervals of 1". This also is performed by the router as shown in Fig. 6. The sheet now is cleaned on the buffing and polishing wheels and is given final inspection before installing.

The following conclusions may be drawn from the material presented above:

(1)—Transparent methyl methacrylate has been successfully dyed with light-fast colors.

(2)—Visual clarity has been improved by use of these colored panels, thus allowing the pilot to see more distinctly.

(3)—Sun glare has been decreased by use of these colored panels, which in the particular case of the B-25 has eliminated several sun glare shields formerly used.

(4)—Although not previously discussed, the effect of sunburn also is decreased, because the ultraviolet light waves are not passed by the colored panels.

Other Possible Uses

Post-war possibilities for this type of product might include such things as colored automobile windshields, which certainly would tend to eliminate driving hazards caused by sun glare. Methyl methacrylate by itself, however, is not recommended for this use because of its soft surface. However, there is the possibility of combining an outer layer of glass with an inner layer of the tinted lighter methyl methacrylate. The same applies to windshields for future lightplanes, motor boats, etc. Decorative home uses, of course, should not be forgotten. Many possibilities exist, such as tinted transparent cupboards, windows, and other similar installations. END

Plastics as Fluorescent Medium

(*Continued from page* 61)

great danger in showing the faintest flicker of a light, have been able to read their navigation charts and myriad dials in the black of night without warning the enemy. All of the gages and instruments on an airplane are marked with fluorescent paint. All the pilot has to do is to turn on an invisible light to clearly read every dial. This black light may be attached to his helmet and automatically directed, so that only the calibrations at which he is looking, glow.

Practically all the transparent dials used are of acrylics, cellulose acetate, polystyrene or vinylite, which make a surface compatible to printing in fluorescent inks. The fluorescent markings may be read on the clear surface in daylight and they appear clearly as glowing figures against the dark at night under black light. There is no reflection or glare from the plastic background. Knobs of either black or dark red butyrate are similarly marked with luminescent paint.

Important Fields Open

Outside the fields of decoration and advertising, these glowing plastics will have a more important use. In industry, dark corners behind moving machine parts, can be papered or covered with fluorescent plastics and the machines will be silhouetted in such a way that the workman can more easily and more safely work against the glow-illuminated background. Emergency exits, stair-treads, danger points can carry warnings made either of fluorescent plastics or those impregnated with luminous material which will glow for a sufficient time after visible light is extinguished.

The post-war world will find many uses for this indirect lighting that we cannot foresee now, but we can foretell with some certainty that however fluorescent and luminescent materials are used, they will be used in connection with plastics—both as a filter to produce black light and as a vehicle to hold the light-active substances. *(This article was prepared and received for prior publication.)* END

Inflated Vinylite Furniture

(*Continued from page* 15)

it gives better fit to the body. Comfort is comparable to that of an upholstered spring chair. There is a decorative covering of fishnet. The chair is supported by aluminum legs, readily attached and detached by means of set screws, an improvement over the drive screws in the earlier models.

Some such model seems to us suitable for Army use behind the lines, for not only is it cheap and comfortable, allowing a variety of body positions, but it also requires little shipping space. The frame and cushion disassembled can be put into a briefcase. We are therefore exploring its possible use with the Quartermaster Corps. After the war it could be adapted for beach, lounging rooms, porches, etc. But this is only a beginning. The sketches by Mr. Miller give some idea of the design variations possible for civilian use after the war.

There is also room for variation in all details of construction. We said we were now using a sheeting 0.020″ thick; we have experimented with a tube as thin as 0.008″ with not unsatisfactory results. For post-war use, we are thinking of an inexpensive mass-produced support for the cushion of plastic laminates. Instead of wooden or aluminum legs, we are thinking of laminated phenolic tubing, to reduce the weight. A chair of this type, with a seat of synthetic fabric (such as Vinyon), could be made entirely of plastics, in one form or another. Breaking the chair up into interchangeable and demountable components brings the principle of prefabrication to furniture. Our first models have weighed 10 or 11 lbs but, with the vinylite tube itself weighing only about 1½ lbs, and with plastic support and legs, we should be able to bring the weight down to 7 or 8 lbs.

The reaction of the public to the first inflated chair has been intense. With its advantages of comfort, appearance and price, we believe the inflated plastics chair has a real future. END

Closures from Extended Phenolics

(*Continued from page* 45)

The continued use of lignin-extended phenolics after the war depends on the availability of phenol and on economic considerations. At present, there is good reason to believe that post-war capacity for phenol will more than meet projected demands from the plastics industry. If this should prove not to be the case, lignin materials will receive continued consideration until additional phenol capacity is constructed.

Under war conditions no particular cost savings have been effected by the use of extenders. With phenolic plastics already at a low price level, it is not to be expected that lignin-extended alternates will offer any marked economies. In this connection, the price competition that all thermosetting materials will meet from styrene-derivative thermoplastics should not be overlooked.

Lignin and lignin-extended materials, however, are relatively new in the plastics industry. Their widespread use during the war may well uncover certain specialized fields where they will serve better than older materials, all factors considered. In this possibility lies their greatest opportunity. END

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Black Light Inspection

(Continued from page 37)

on the surface of the parts to be drawn by capillary action deep into any defect open to the surface. Plastics generally require one or two minutes of penetration time.

The excess penetrant is removed from the parts by spraying them with water forced through spray nozzles at standard water pressures. Parts are quickly dried in a recirculating hot air dryer, and a thin film of developing powder is applied. This powder draws the penetrant to the surface by blotting action and makes any indications brilliant and sharply visible in black light.

Inspection is carried out in a semi-darkened area or booth. Parts are viewed while bathed in intense near ultraviolet light in the band between the visible and sunburn producing true ultraviolet range. Black light is non-injurious to the eyes or skin. Any defect in the part glows during inspection as the penetrant at the defect fluoresces under the black light, a brilliant yellow-green line marking any crack. This fluorescence is due to the penetrant's ability to absorb the invisible black light and emit visible light rays.

Defects

In common with other fabricating materials, plastics may exhibit a number of defects peculiar to their composition and methods of manufacture. Among these defects are:

Gas cracks and blisters from improper venting or curing.

Distortion cracks, from excessive straightening by the operator, improper jigging before complete cure, or improper draw; these show up following the curing and cooling.

Shrinkage cracks around inserts, generally caused by improperly located, or movement of, inserts; these usually begin to manifest themselves during the cooling process.

Cracks from improper ejection or removal from the mold; these may be caused by misalignment of the ejector pins, or by carelessness in removing die parts.

Cracks due to careless handling or machine operations such as drilling or tapping, force fitting of parts or other manufacturing steps.

Injection molding defects. Excessive cooling of the plastic as it enters the mold may cause extremely fine tight folds in the skin of the parts, setting up a condition akin to "cold shuts" in metal castings.

Operating Procedure

Essential equipment for the fluorescent penetrant inspection method includes a means of applying the penetrant (usually by dipping) a water spray rinse, means for drying,—and a powerful black light source for inspection in a darkened area. Developing powder is usually applied before inspection but may not be necessary in all cases.

While simple setups can be used, it is advisable to obtain carefully engineered equipment for best operation and economy. Specifications for such equipment differ as widely as the variables of size, shape and quantity of parts to be inspected. Automatic machinery has been developed for specific applications, while manually operated units can be used for the usual run of miscellaneous parts. A small general purpose unit is shown in operation at the top of Page 37. Parts are handled in a 12"x12" basket. They are dipped in the penetrant at the far left and set on the drain rack at the back. Rinsing is accomplished in the next compartment under the glow of a black light which aids the operator in judging the progress of the wash. Next comes drying in the recir-

culating hot air dryer, then application of a developing powder in the tank and inspection in the curtained booth on the right. One man can process and inspect about 500 small parts in an hour. On very small parts, with one man doing the processing, it is possible to have additional inspectors at individual inspection desks where they receive the processed parts from a central dip unit. Among the important uses for fluorescent penetrant inspection of plastics is the control inspection of the first parts made in a new mold By showing the most minute defects invisible to the eye in normal light this type of inspection helps to establish proper molding procedures on a new job and serves to set up preventive measures for reduction of rejects. END

Precision Models Aid Sales

(*Continued from page* 47)

metal is then poured through the riser opening which has been left in the bottom of the mold. We allow a ten minute cycle for the metal to cool, then the steel strips and die pins are removed and the casting is drawn from the mold. All that then remains is the breaking off of occasional slag, painting and final hand finishing. We are then ready for another pouring. Some of our molds have produced hundreds of models, and thus far there is no visible limit as to the number of models which can be made from a single mold.

There are many purposes for which models of these types can be used. Their value in three dimensional selling has already been mentioned and, judging from orders already received, this use will sky-rocket in the post-war period. They are also invaluable for window display and demonstration purposes.

Recently the Army had need for a photograph of one of its trucks in a tropical setting. We were asked to reproduce a model of the truck for them and smeared with mud, its fenders dented, it was photographed against a man-made tropical background.

At the present time we have an order from a nationally known company for a large number of precision small scale machine tools. The models will be used in setting up the location of equipment in new plants.

Sales possibilities inherent in this method are exemplified by the sales kits we are making for Allis-Chalmers. These 3" by 4" models are accurate representations on a scale of ½" to 1 ft (see illustrations on page 47) of switchgear boxes, transformers and other installations used in power substations. The units themselves are made of wood but plastics molds made it possible to cast in metal the almost incredibly small details—valves, switch handles, lifting hooks, knobs, manhole covers and other parts—varying from ⅛" to ½" in overall size. As shown in the illustration, they provide an Allis-Chalmers salesman with a vivid, three-dimensional presentation of the equipment he is selling.

These are but a few of the uses for accurately scaled models. Once very costly, they are now reasonably inexpensive, their cost having been cut sharply by this new development of plastics molds.

On an equal volume basis, for example, the cost of making the Hallicrafter truck model by this technique is a fraction—at the most, 10%—of what it would cost to make it by hand.

Their use in the post-war period, particularly in the sales, advertising and educational fields, should greatly increase. Chalk up another contribution by plastics. END

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PROBLEMS in *plastics*

Problems and questions may be submitted to this department for answering by the technical editors or specialists in the industry.

We have been looking for a plastic which can be substituted for glass in the manufacture of laboratory equipment such as graduates. It has been found that polystyrene nearly measures up to our requirements, but we would like to make sure that there isn't some other material which may be better suited to the purpose. *F. J., Jackson, Mich.*

Polystyrene should be a reasonably satisfactory material to substitute for glass in manufacturing laboratory equipment. Some other plastics worthy of consideration are methyl methacrylate and vinylidene polymers.

* * *

Our research department is considering the possibility of using plastics in place of pressed metal forms in the manufacture of domestic electrical products which include electrical heating units. We would need a water-clear transparent plastic that could stand up and keep its shape, being transparent and odor free even at roasting heat. We would like a plastic which we could mold in our own plant if possible. *J. C., Marlborough, Mass.*

No clear plastic is known which will stand a "roasting heat." The heat resistance may be increased by the incorporation of certain inorganic fillers; the plastic then is not transparent.

* * *

We are interested in contacting a manufacturer making a plastics container for an individual typewriter ribbon, if such a thing is being made. If you can put us in touch with anybody who is doing this work, we will greatly appreciate it. *A. C., New York City*

We have no information as to a manufacturer who fabricates a plastics container for an individual typewriter ribbon. Perhaps the publication of this inquiry will elicit such information.

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Plastics Overseas

(*Continued from page* 81)

Consider steel. Plastics are reckoned to be capable of eating deeply into the traditional steel territory. But the current production of plastics, with all its war stimulus, and for all that it has multiplied many times since 1939, is hardly more than 1% of world steel production.

Another point of importance that tends to be overlooked in telling the plastics future is that international competition can hardly be prevented from growing on the widest scale. As things now stand, it is probable that in plastics generally, petroleum-based and coal-based, thermoplastic and thermosetting, Germany is the most advanced country, with the United States a close runner up. The British industry is some way behind, and, with the U.S. holding the rights in practically all plastic molding powders, it will not be easy for her to make up the gap.

When the war is over, unless there is intimate agreement between the industrial countries, there will be competition of a most intense sort between them, and while in the initial reconstruction period this is likely to be partially concealed by the domestic priorities on production for urgent purposes, this very concentration must later lead to a great rush into the international market, to find outlets adequate to expanded industrial capacity and appropriate to the capital invested. What this is likely to mean is, in the end, a division of labor. Plastics are no longer a single industry, but many industries, each with its own differing sources of supply, based on different raw materials, each with its own manufacturing processes, and each with its own differing outlets. It is possible that a rough and ready geographical division of labor might arise, according to the location of the most important raw materials—perhaps petroleum in the United States and coal in Great Britain. END

PHOTO CREDITS

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FRONT COVER

The Western Electric worker shown is processing tubular fuses used for telephone communications. At present the housing of the fuse is made of hard fiber. Telephone engineers are actively investigating the substitution of plastics for this application. The plastic housed fuse now being laboratory-tested looks exactly like the fuse in the illustration.

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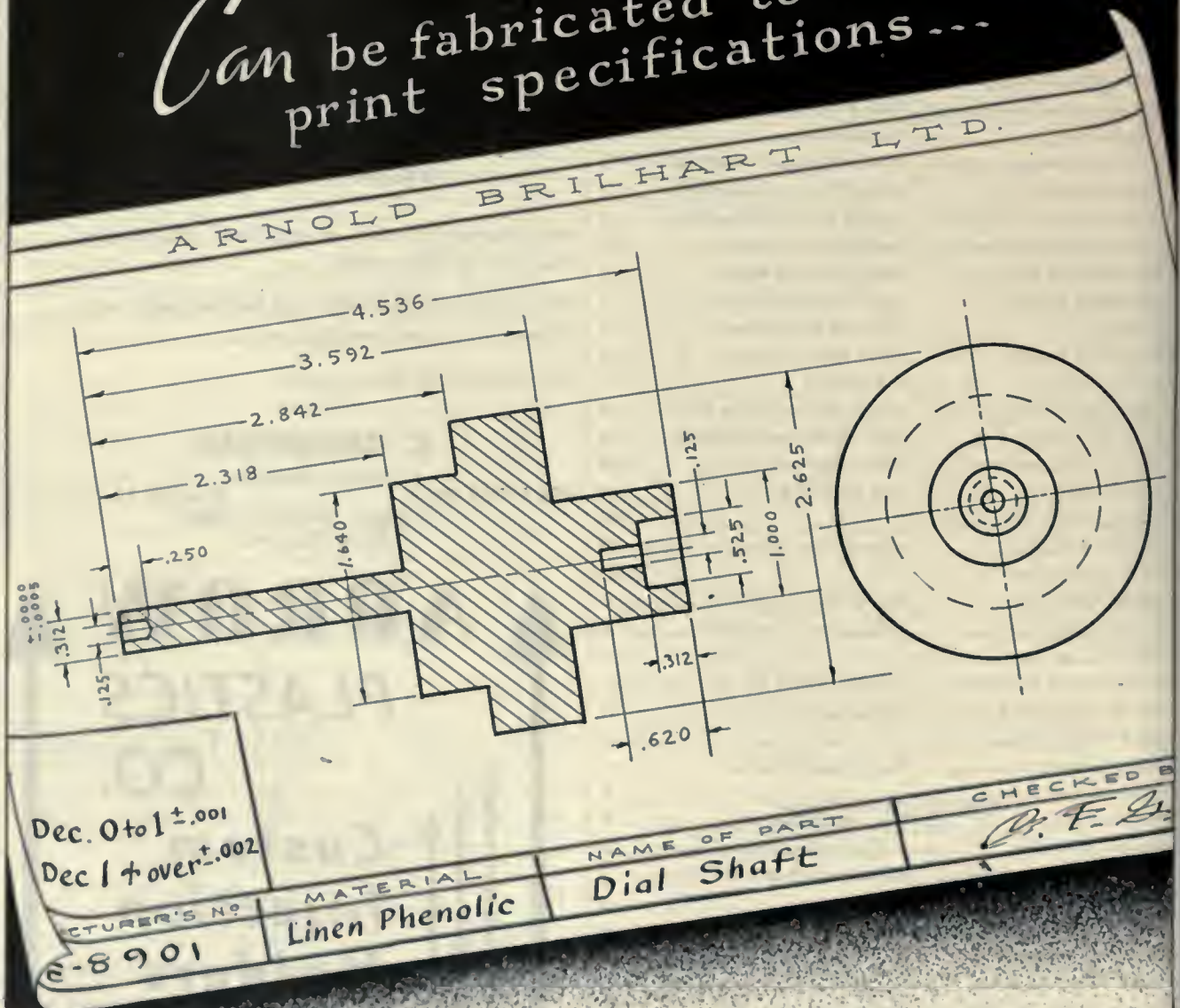

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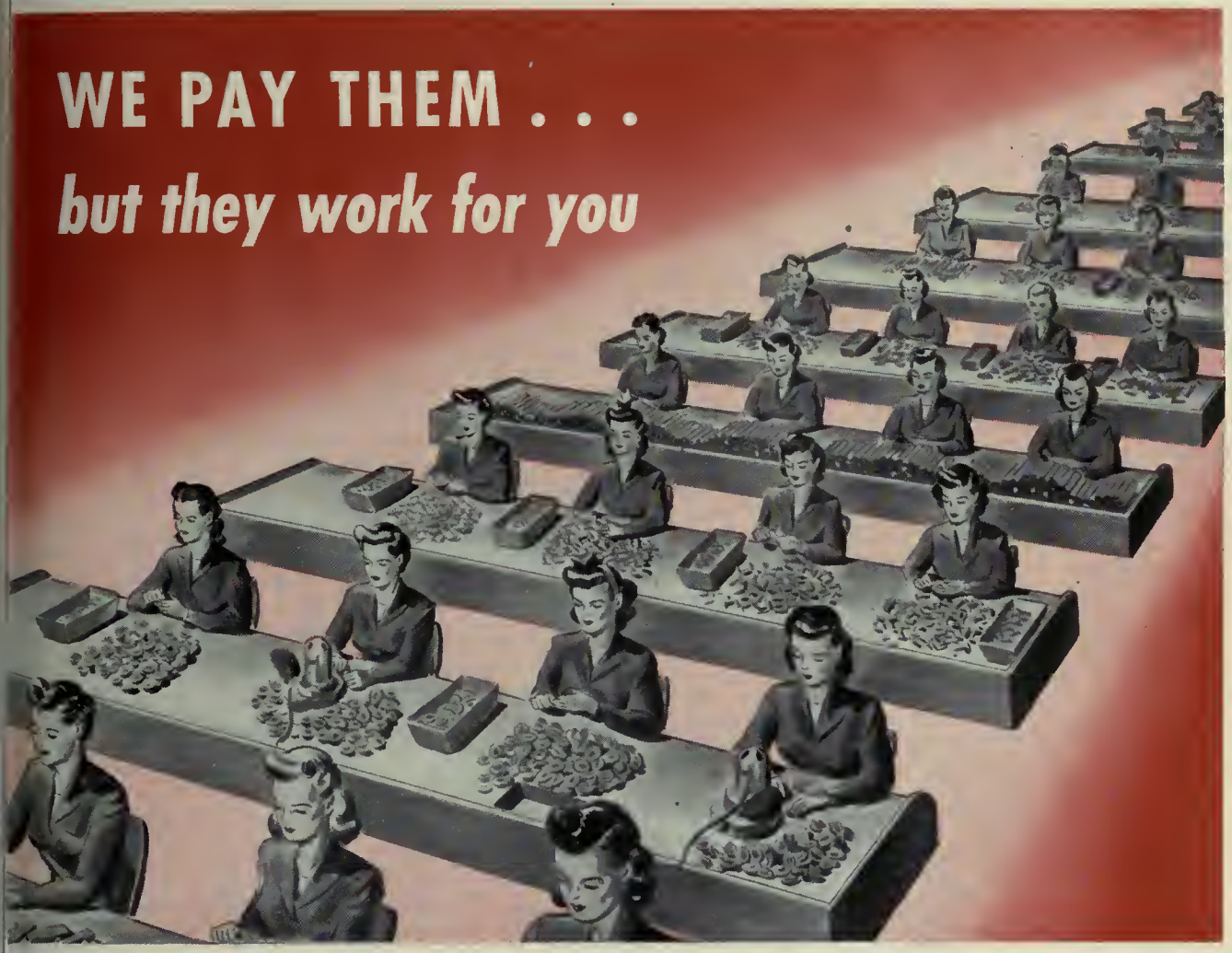

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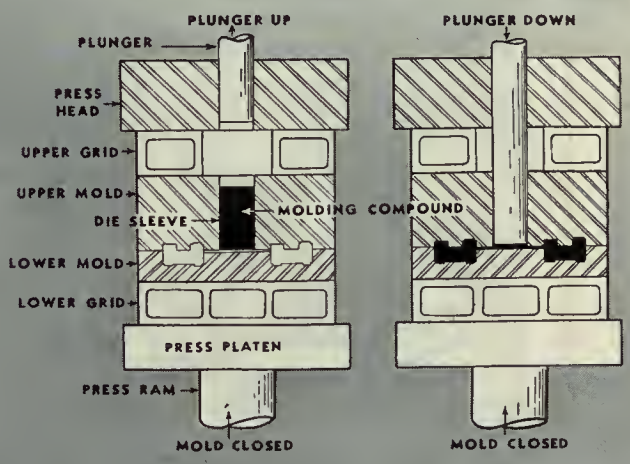

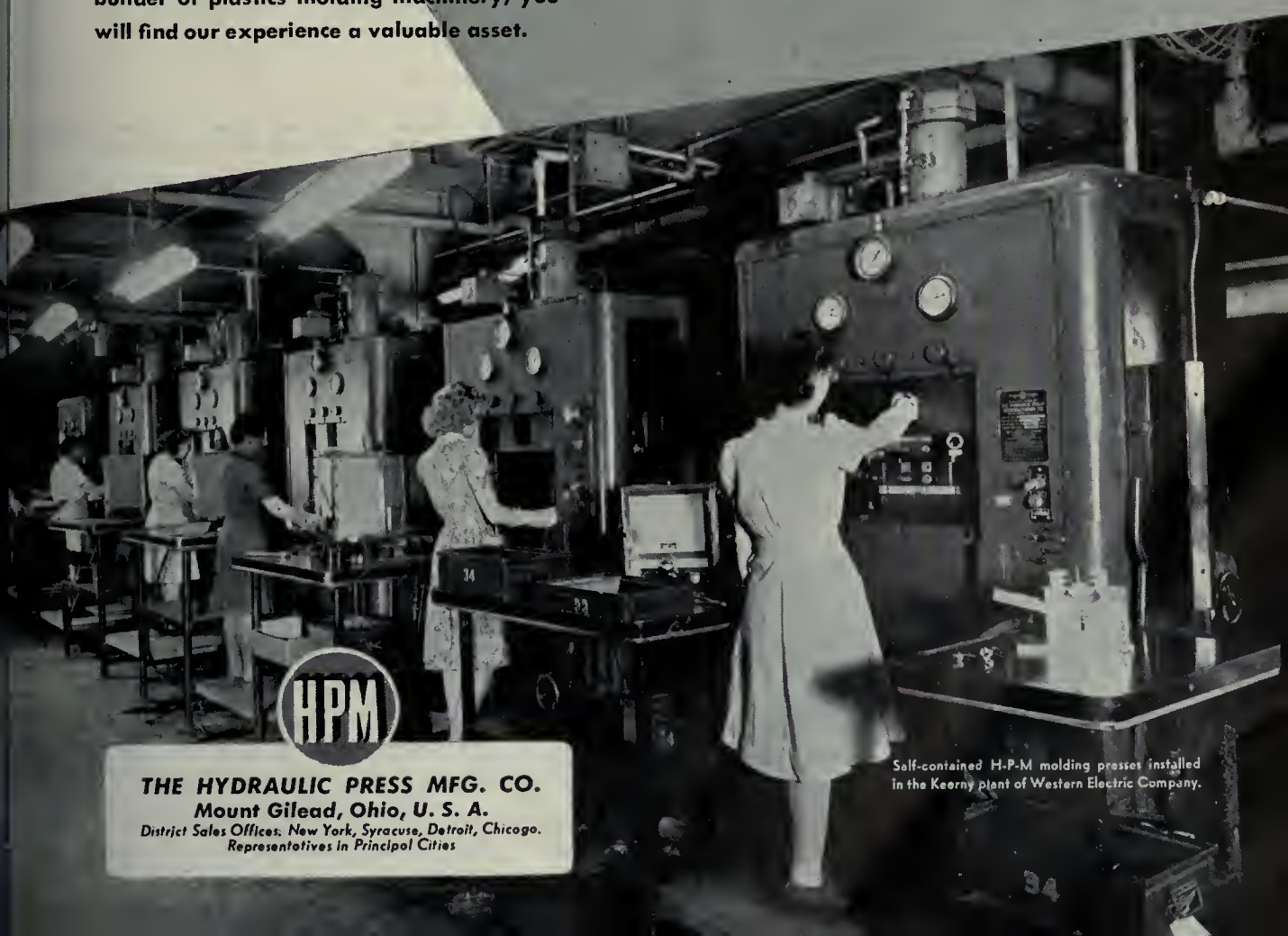

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FRONT COVER: Utilization of methyl methacrylate for hypochlorination unit is shown in the Proportionaar "Chem-O-Feeder." For details, see page 26.

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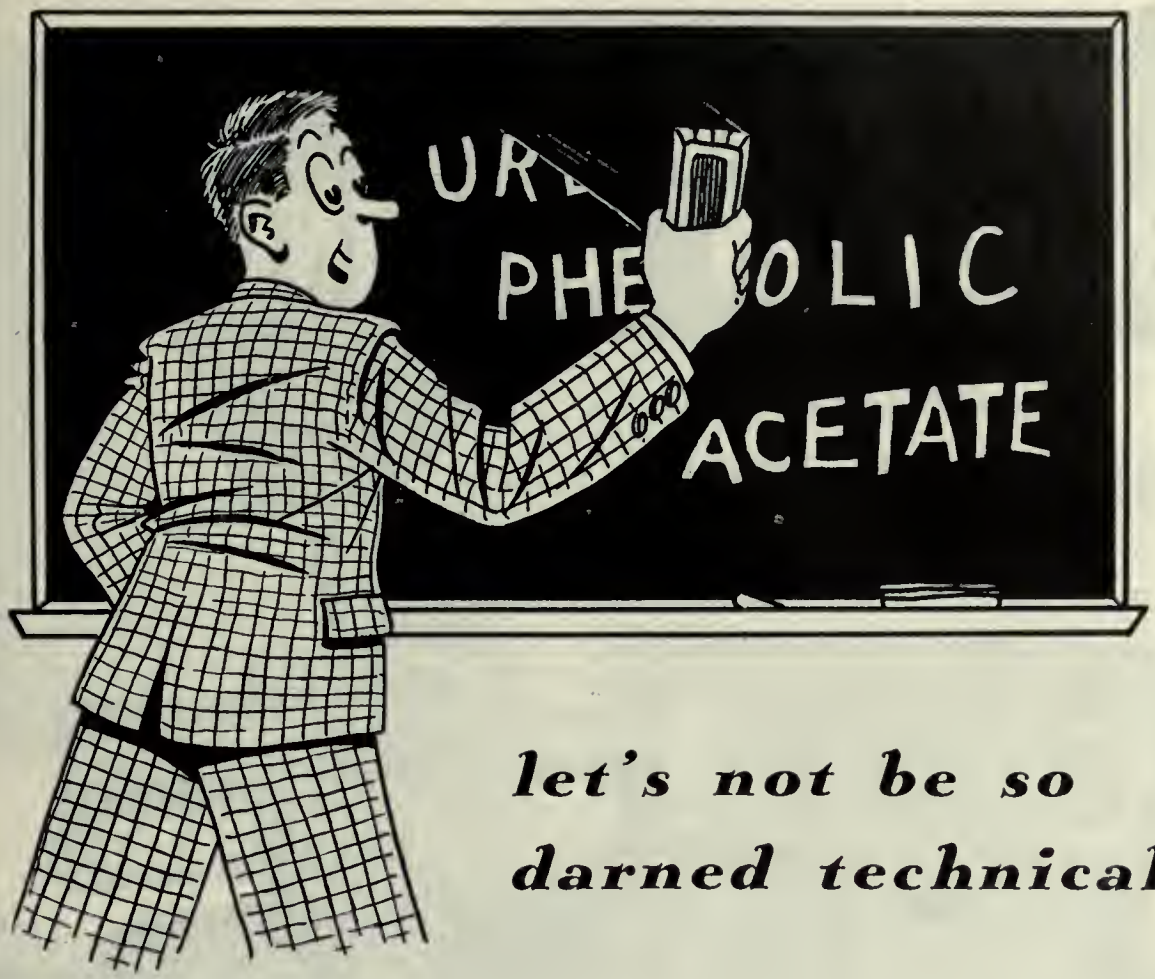

let's not be so darned technical!

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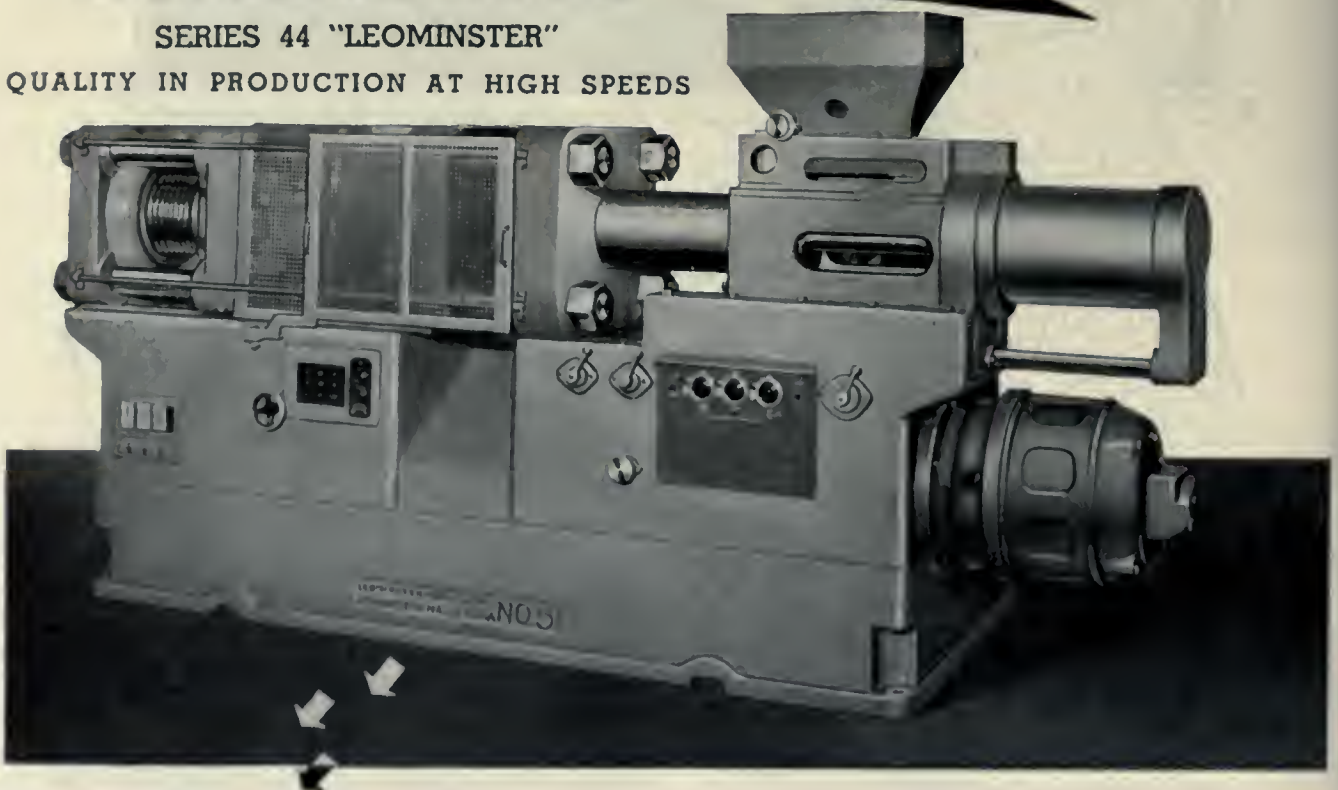

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HOW TO CEMENT PLAX POLYSTYRENE

Three different types of cement can be used with polystyrene.

1. Solvent. Cementing with a solvent is similar in principle to welding. The solvent softens the polystyrene surfaces to be joined. The surfaces are held together under light pressure. The softened surfaces unite. The solvent is absorbed by the body of the plastic and the joint becomes solid and rigid. In this method, surfaces must fit exactly before the solvent is applied. Machined surfaces are usually cemented by this method.

2. Polystyrene solution. A thin layer of dissolved polystyrene is spread over the surfaces to be joined. The pieces are held together under light pressure. The solvent in the solution evaporates or is absorbed, leaving a joining layer of solid polystyrene. This method of cementing does not require perfectly fitting surfaces because the dissolved polystyrene in the cement will fill small surface irregularities. However, close tolerances cannot be maintained because the dissolved layer of plastic will vary with each application of cement. The bond will take from 12 to 36 hours to dry because a large amount of solvent is introduced at the joint. This method of cementing can be speeded by using a thicker solution, which has been warmed to make it fluid. Thus the amount of solvent to be evaporated is reduced.

3. Adhesive. This can be used to join polystyrene to other materials and to metal. The Thiokol, Glyptal, and Reanite Cements are variations of this type. These cements are classed broadly in three categories: drying adhesives, non-drying adhesives, and curing adhesives. The drying adhesives are most commonly used. The non-drying materials are weak in shear but extremely resistant to vibration, while the curing adhesives are temperature resistant. When partially cured, such adhesives give welds having a high degree of vibration and temperature resistance.

When cements employing a polystyrene solvent are used, and most cements do, the unit should not be stressed or assembled until dry. The solvent softens and weakens the polystyrene. If a load is applied, before the solvent evaporates and the plastic becomes rigid, the chance for distortion or cracking is great.

In many instances, heat sealing may be used instead of cementing.

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PLASTICS in PERSPECTIVE.....

FOR several years, leaders of the industry have called for increasing coordination between manufacturer and designer, stressing the need for "dressing up" the utilitarian creations of the former. Far from diminishing in recent years, this demand has increased, as manufacturers think ahead to post-war years of competition with other materials.

It is apparent from this that, although specialists who design in plastics have sprung up in the last several years, they have yet to receive full cooperation from the industry. True, the designer tends to push ahead, calling for uses and shapes which may be at the moment beyond the capabilities of plastics; and producers sometimes resist efforts at expansion into unproven fields, but the fact remains that only through complete harmony and constant contact between the two groups can the industry continue to forge ahead after the war at a pace anywhere near that of the war years.

The question today is, what will the effect on plastics be when, after the war, metals, wood and other materials again become plentiful? The answer is that superior design and utility will command the sales—even at premium prices. The public may not care a fig whether an object is made of one material or another so long as it does well the job for which it was intended, and is attractive and satisfying. During wartime, plastics manufacturers have taken seven-league strides toward improving the physical and chemical properties of their products. What remains is to plan ahead now for the post-war civilian market, with its emphasis on sensory appeal, by adding to products those touches of form and beauty which will make the term "plastics" a synonym for desirability.

•

AS increasing numbers of new plastics applications have been developed, a certain small proportion of them turned out to be misapplications. This is inevitable in an industry which has progressed as rapidly as the plastics industry has. We are familiar with the instance where the wrong type of resin was chosen for a particular use. That was usually the dubious achievement of someone out to make money in a hurry. Yet, there is an instance in which the money motive played no part—in which utility was the sole motive—in which the plastic chosen had the right properties for the purpose—and yet it was wrong for the installation under discussion.

The case we are referring to was the Navy's installation of plastic couplings in a refrigerating piping system aboard a battleship. The coupling was entirely satisfactory so far as the working of the system was concerned. The trouble developed with the cleaning of the system, for which the Navy as per ancient custom—uses live steam. Naturally, the coupling never was intended to withstand such temperatures, and it failed in service.

It is plain from this example that too much caution cannot be observed that before putting any plastic to a new use, the *total situation* must be studied and examined carefully from every viewpoint. One cannot simply rest on the satisfaction of certain mechanical and chemical requirements. He must know all the circumstances in which the product is to be used. In the case cited, the cleaning agent was overlooked; in other cases, it may be an adjacent material in the installation, perhaps with a different coefficient of expansion.

Engineers don't often slip up on such matters. But it is especially important for the growing plastics industry that the number of misapplications should become vanishingly small. For all their excellent performance in innumerable uses, plastics are still regarded with a hypercritical eye. They are still on probation. That shouldn't phase us—we can stand being put on our mettle, indefinitely. We know we are headed in the right direction industrially.

•

WHEN we were talking about what all good citizens of the industry usually talk about, the newcomer to the industry was expressing his pleasant astonishment at finding something new developing every day. A veteran of the materials end of the business listened for a while, smiling to himself, and then he confessed that he too was still meeting up with surprises. "Someone is always thinking up something to do with our stuff which we ourselves don't foresee. And not long ago a firm came out with a type of product new to plastics, made of our material—after we had told them we didn't think it could be done!"

•

LAST month we all exulted perhaps a bit prematurely, at the downward trend in plastics prices. But since then most manufacturers of cellulose acetate—the Tennessee Eastman Corporation being a major exception—have raised their prices three or four cents a pound—roughly 10%. Furthermore, the Office of Price Administration has ruled that the increase is to be borne by the molders and extruders and not passed on to their customers.

The acetate manufacturers, claiming to have absorbed the higher cost of the substitute plasticizers for some time, are still, in some cases, bearing part of that cost. They also claim that the increased unit cost to the molder is negligible, and are therefore not disposed to yield further ground to them.

The only redress open to the molders is to appeal to the OPA for relief under the undue hardship clause of MPR 523, so clearly explained in this issue by S. S. Ullman, administrator of the order. But each molder must state his own case—there cannot be an appeal as a group. The only other source of relief would be an increase in the production of the phthlates—an increase which will be large enough to permit their reinstatement as plasticizers for cellulose acetate. Although no definite assurance of such a move has been forthcoming, a real effort is being made to have it materialize.

There is no doubt that acetate prices would then come down and a source of friction between the necessarily divergent interests of the industry be removed. END

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Tomorrow's plastics home should have durable, low cost beauty; coordinating the ideas of designer and engineer

The Influence of Plastics on Post-War Homes

By Frederick Z. Pearson
Manager, Plastics Division
Lyon Metal Products, Inc.

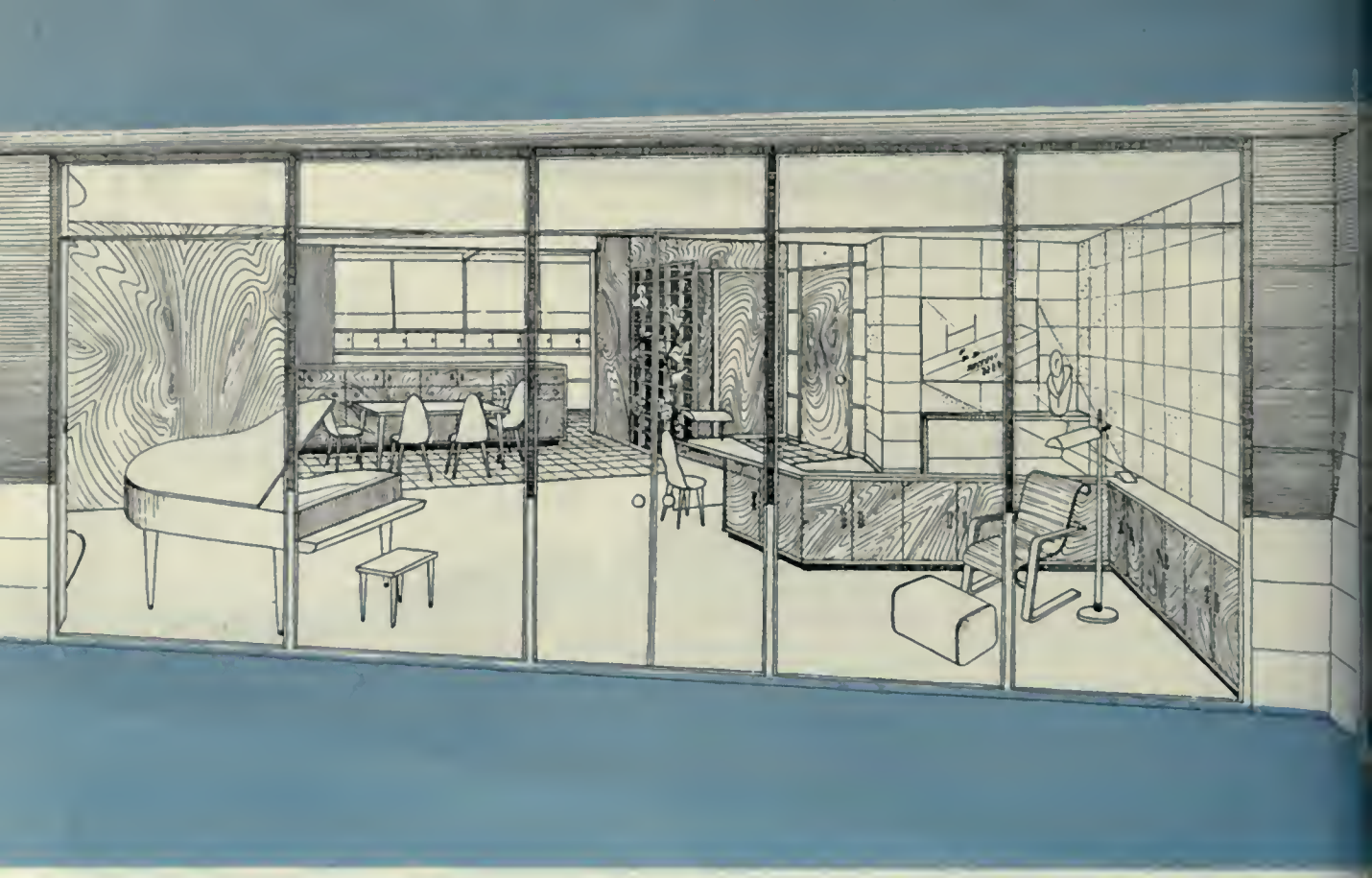
Future Domestic Possibilities Must Avoid Impractical, Costly Pitfalls

Artist's plan view of home shown above

TOO many impractical, uneconomical, briefly unsound applications of plastics have been proposed by visionaries who have little practical experience in the plastics industry. The capable industrial designer now has a host of plastics materials at his disposal, and if he applies these *correctly*, he will discover they will give excellent performance at moderate cost. Therefore, he must either make a broad first-hand study of the different materials and techniques and what they will or will not do for him, or he must consult the experienced plastics engineer, before specifying any particular material or method.

Let us see what can be done, post-war, with existing materials and proven methods. The accompanying illustrations show the four basic units of any home-plan, as designed by W. C. Nichols and Joseph Palma, Jr., industrial designers and consulting engineers of Chicago. These designers expressly desired to apply a variety of prime raw materials —plastics and metals—in a harmonious combination which would allow each material to give the consumer *maximum performance at minimum cost*. Plastics were used to provide a beautiful permanent finish, and to obtain intricate shapes at moderate cost. They are admirably suited to mass production and its obvious economies.

To give John Public the pleasant surroundings illustrated here, and most important, remain at the same time within the limits of the average pocketbook, large scale production is an essential. Only large production runs make possible



Living and dining space will be characterized by unconventional contours

economies in the use of factories, tools, and labor. It is in this direction that we can expect the principal advantages of the prefabricated home industry, because it provides for large scale production of the major parts of the house and its appliances.

This young, aggressive field provides precision-manufactured, structural units that can be rapidly assembled into an attractive house of immensely improved permanence and livability compared with conventional house-building methods. Such units can be designed to offer the utmost in strength, permanence, and beauty. The immense quantities of standard dimension parts lowers the cost of these sub-assemblies to the point where the finished home is well within the reach of the average man.

Horizontal refrigerator, plastic tiling and appliances are featured in the kitchen

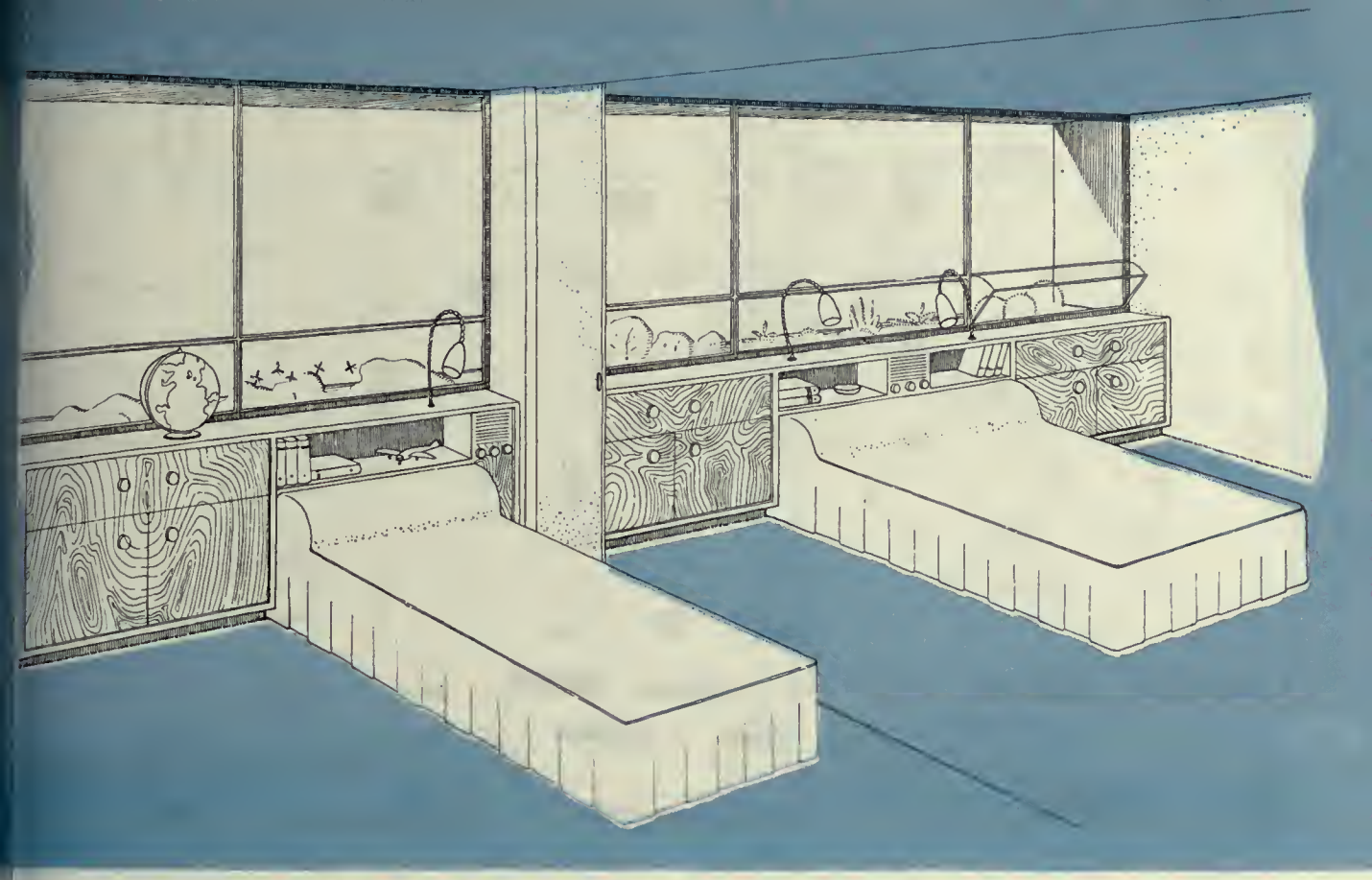
Removable partitions made from plastics-treated plywood, or hardboards faced with decorative laminated paper base plastics, will allow increased flexibility of interior arrangements, and permit changing of room sizes at will.

In this respect, the use of opaque plastics sheets, fastened to the walls, and held at the ceiling and floor in roller tracks like an over-sized window shade in vertical position, is suggested by the designers.

Rigid plastics slats also have been proposed to be used in the same connection, like a Venetian blind standing on edge. As yet these constructions are costly, but their future use is entirely possible.

A controversial item is the plastics window. The so-called "greenhouses" on the Flying Fortresses and other aircraft are made from those non-shatterable transparent plastics, because that is the major characteristic required. Their use in the home, however, seems barred by the high first cost. It is often forgotten that glass is a low cost material, with excellent properties, that has been much improved during the war. However, the author does not mean to imply that plastics windows may not become a reality. If clever use is made of the inherent characteristics of plastics materials, that is to say those properties which cannot be provided by other materials, they will certainly be used in many applications where they presently do not seem to fit. For instance, it would be possible to cast in one continuous piece, the window and the casement, and so create a large transparent area, the reinforcing casement while being there, not interfering with the vision. Remarkable progress has been made in the allyl resins, which are transparent, clear thermo-setting casting resins of considerably improved surface hardness and scratch resistance.

The exterior surfaces of the house should be strong, permanent, good heat and sound insulators, and low in cost.



Plastics are effective in beds, cabinets, walls and in the partition which makes two rooms of one

The plastics plywoods seem well suited to this type of application, especially in connection with the new bonding methods that have been developed in the form of Chrysler Cycle Welding, and other rubber-resin cements. These methods allow assembly of wooden surfaces to either metal or wood frames, in a speedy and simple manner, especially where use can be made of high frequency electronic heating.

In the accompanying illustration of the future living and dining space, it almost seems old-fashioned to call it a "living *room*," as the square or rectangular dimensions usually associated with this word have been eliminated. The major part of the wall panelling employs beautiful plastics impregnated plywood panels, which are relatively inexpensive, and provide the intense natural beauty of the woods. At a slight increase in cost, these panels can be faced with paper carrying a photographic reproduction of rare wood species. After impregnation with plastics, and bonding to low-cost plywood or hardboard panels, they yield the breathtaking beauty of such rare woods in so truly a reproduction that they can hardly be found to be an imitation by others than the experts. The same materials are used in the cabinets, the buffet, and the dining table, and in the piano, too. The well-known piano builders, Steinway & Son of New York, have, during this war, done outstanding work with regard to electronic assembly methods of wooden parts. They may use this experience to advantage in the construction of superior "grands" after the war.

The wall of the television corner of the room, to the right, uses plastic tiling consisting of laminated paper base plastics. This material is a combination of strong kraft paper and phenol formaldehyde resins for the core, and lustrous, colorful melamine formaldehyde in a fine rag paper as a surface. The telcvision screen is of a similar construction, but contains the proper pigmentation.

Now, let us study the chairs. The dinette chairs in the background, have a one-piece molded seat and back. Most likely the material would be a laminate, cloth or paper, impregnated with phenol formaldehyde resins. Better yet, they could make an excellent application of the resin fibre molding process now emerging from pilot plant production. A convenient saddle is molded in, making a comfortable arrangement. Further, these chairs require no other attention than wiping with a wet rag when dirty. The chair on the extreme right is another type of plastics construction using a simple curved piece of plastics sheet material. This could either be plastics plywood, plastics faced hardboard

(*Continued on page* 91)

A new concept of tub and shower design is found in this bathroom

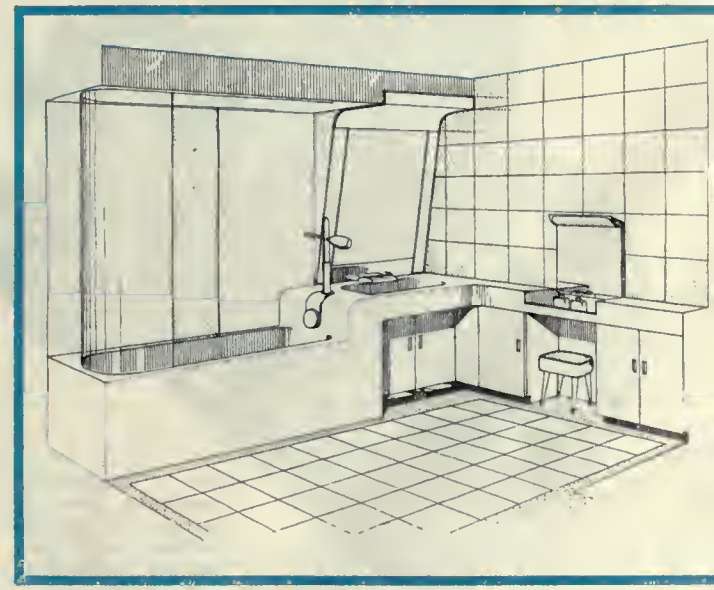


Fig. 1. A profuse variety of shapes, types and materials are used as inserts in parts made of plastics

Designing Inserts for Plastic Applications

By J. H. DuBois
Commercial Engineer
Plastics Divisions, General Electric Company

How to Meet Problems Created by the Use of Plastics with Dissimilar Materials

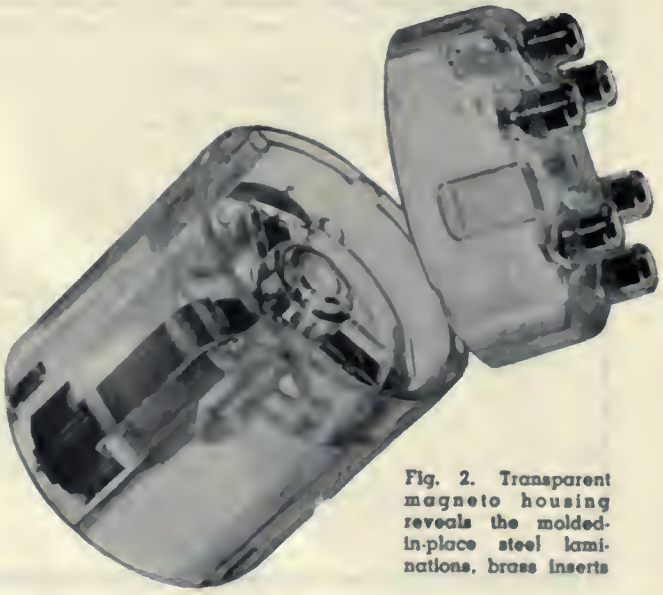


Fig. 2. Transparent magneto housing reveals the molded-in-place steel laminations, brass inserts

JUST as certain plastic parts have added to the usefulness of products hitherto made entirely of other materials, so, conversely, have these other materials been put to use by the plastics industry to extend the services performed by its products. In the form of inserts, such substances as silver, brass, steel, aluminum, copper, zinc, laminates, vulcanized fibre, glass, mycalex, porcelain, special alloys, rubber, calendered cloth and wood have been extremely valuable to the plastics industry. Typical examples are shown in Fig. 1.

Some inserts are molded into the product for maximum holding and insulating value, while others are pressed into molded holes after the product is removed from the press. Inserts play a vital role in providing internal and external threaded sections, terminal studs wire attachments, shafts for rotating parts, contacts, rivets for attachment of metal stampings, bearings, glass panels for visibility, name plates, internal electrical connections, laminations for magnetic circuits, reinforcement, thermal conductivity, functional component parts, decorations, pipe connections, flexible members and localized special-purpose insulation.

An important recent development has been the addition of a metallic alloy which has a thermal coefficient of

expansion similar to that of the asbestos-filled phenolic plastics compounds. This development will permit the use of thin sections with inserts in certain applications where the differential expansion rates caused trouble when the conventional metals were used.

Very effective use is made of an insert in the construction of a total head tube, used in the measurement of air flow. Based on a Boeing design, this application for plastics was first proposed by United Aircraft Corporation and the molds were built for them. The insert for this part is made in two pieces; a brass screw machine base with a short curved section of steel tubing for the orifice. The tricky molding job is accomplished by transfer molding since the insert may be fully supported by the closed mold members before the wood-flour-filled phenolic compound is injected.

Electrical apparatus today is being reduced in size and cost while at the same time, its efficiency and the quality of its electrical insulation is being increased. A magneto shown in Fig. 2 makes use of molded-in steel laminations to obtain the maximum efficiency in the magnetic circuit and at the same time, reduce the weight and size of the unit. The stampings are formed by punchings which are cleaned of scale and grease. They are coated with a phenolic resin and the solvent is permitted to evaporate before they are clamped in spring pressure clamps to maintain the pressure after the varnish is squeezed out. A baking operation cures the resin, producing well-bonded lamination cores that are also well insulated, so that noise will be eliminated and eddy current losses minimized. The cores thus produced may be loaded in the molds in the conventional manner.

A brush yoke for a new electrical device necessitated a series of studs for the mounting of the brushes with each alternate stud connected for one line and with the other studs connected to ground. This problem was solved by means of the inserts shown in Figs. 3 and 4. It will be noted that the line brush pins were connected by a copper wire which has been Sylphos-soldered to the phosphor bronze pins. This attachment means was used because wires attached by less substantial methods were torn from the pins by the entering compound. The discs, shown in Fig. 3 were punched from resin-impregnated molding board and these were loaded in the top and the bottom of the mold to form the upper and lower surfaces of the molded piece. They served to prevent the wires from being forced to the surface when the compound entered the mold and insured the presence of a minimum thickness of insulation over the wires. The long strips of resin-impregnated molding board shown in Fig. 3 were loaded in the mold on each edge side of the connecting wires to insure the presence of the minimum essential thickness of insulation. Cotton-flock-filled phenolic compound was used to fill out the molded part by the transfer molding process, since it would bond well to the resin-impregnated board to form a strong plastic section.

Internal connections of this type are most helpful since their use greatly simplifies the product assembly by making the essential insulation also serve as a structural part. In one product the internal connections are supported during molding by means of laminated pieces which are placed in the mold before the inserts are loaded. Transfer molding is almost a necessity for the production of products of this type, since the incoming material in the fluid plastic state will cause much less distortion than that experienced with conventional compression molding.

Vulcanized fibre provides arc resistance that is unobtainable with the phenolic compounds, and stamped sheets are often molded as inserts in molded products to provide an arc-resisting surface where it is needed.

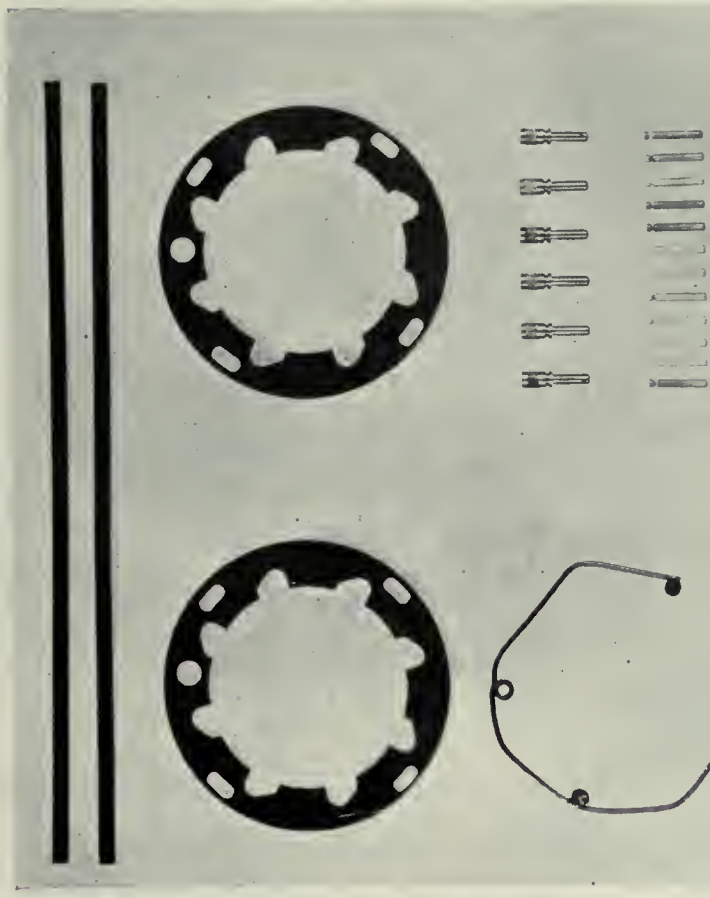


Fig. 3. Metal and molding board inserts used in the production of pieces for electrical brush yoke in Fig. 4

Fig. 4. Phantom view (top) shows inserts molded in place using transparent compound. Actual yoke shown at bottom

Fig. 5. Dropping the insert into a molded recess on the valve handle during assembly to the stem cuts molding costs

Molded Recesses

It is often possible to assemble inserts in a molded recess after molding to reduce costs and to permit one piece to serve in several applications. Inserts were formerly molded in valve handles of the type shown in Fig. 5. A re-design of this part permitted the insert to be dropped in a molded recess on the molded part during its assembly on the valve stem. This change saved the cost of handling and loading the inserts in the mold. Since several sizes of handles are used and since the inserts varied with the application, the manufacturer stocked the insert types required and the various sizes of handles for selective assembly as needed. Thus, this change not only reduced the part cost but it also cut in half the stock of parts and the mold insert-holding combinations that were needed. Other inserts assembled after molding make use of roughened surfaces which hold tightly to the plastics material when driven into place.

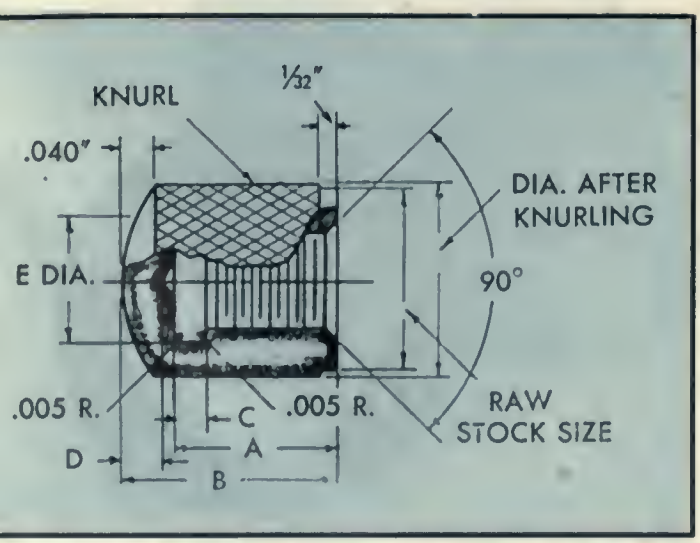


Fig. 6. Design for a standard general-purpose female insert without sealing ring, intended as flush-molding stock part

Another type of insert is a small tapped "C" clip that is easily produced at low cost. It is merely pressed into place and held by the attachment screw. It may be used on molded or laminated products. Attachment devices for injection-molded parts should be assembled on the piece after molding when possible, for their inclusion during molding will prevent fully automatic operation of the injection machine and introduce an important penalty in the cost element.

The design of inserts necessitates several considerations. Well-designed inserts must be easy to load, they must come free easily when the part is knocked out of the mold. Inserts must not crust or distort, and tolerances should be close for a tight fit in mold members with shoulders to stop the flash from flowing into threads and holes. Inserts must have sharp corners at the shoulders, otherwise compound will flow in from below, raising them up out of position.

Standard Inserts for Molded Plastics*

Part No.	Tap Size	Tap Drill Size	Ream After Tapping (+.001")	Raw Stock Size (In)	Dia. After Knurling (In)	A (.005") (±In)	B (±.006 —.000") In	C (±.005") In	D (Min) In	E (.005") In
1	4-40	0.0860	0.0890	3/16	0.199	3/16	0.210	1/16	0.038	0.117
2	4-40	0.0860	0.0890	1/8	0.199	1/8	0.240	1/16	0.038	0.117
3	6-32	0.1065	0.1094	3/16	0.199	3/16	0.240	1/16	0.038	0.143
4	6-32	0.1065	0.1094	3/16	0.199	1/4	0.303	1/16	0.038	0.143
5	6-32	0.1065	0.1094	3/16	0.199	3/16	0.365	1/16	0.038	0.143
6	8-32	0.1339	0.1360	1/4	0.262	1/4	0.303	3/32	0.038	0.169
7	8-32	0.1339	0.1360	1/4	0.262	3/16	0.365	3/32	0.038	0.169
8	8-32	0.1339	0.1360	1/4	0.262	5/16	0.428	3/32	0.038	0.169
9	10-32	0.1562	0.1610	3/16	0.324	1/4	0.303	3/32	0.038	0.195
10	10-32	0.1562	0.1610	3/16	0.324	3/16	0.365	3/32	0.038	0.195
11	10-32	0.1562	0.1610	3/16	0.324	5/16	0.428	3/32	0.038	0.195
12	1/4-20	0.1990	0.2031	5/16	0.387	5/16	0.443	1/8	0.053	0.255
13	1/4-20	0.1990	0.2031	5/16	0.387	1/2	0.568	1/8	0.053	0.255
14	5/16-18	0.2570	0.2610	1/2	0.512	5/16	0.443	1/8	0.053	0.318
15	8-36	0.1360	0.1378	1/4	0.262	1/4	0.303	3/32	0.038	0.169
16	8-36	0.1360	0.1378	1/4	0.262	3/16	0.365	3/32	0.038	0.169

*Exemplified by drawing below.

Anchoring Inserts

Anchorage for inserts is provided by several means. Screw machine inserts are often made with a diamond knurl. A very coarse knurl is necessary when used in the heavy cloth-filled phenolics. Hexagonal rod stock is used with annular grooves for tension anchorage. Inserts made from hexagonal stock must be turned round at any point that enters the mold, since a hexagonal hole in the mold to receive an insert would be costly. Hexagonal inserts should not be used in bosses, because the sharp corners may produce stresses that will cause cracks. Inserts with sharp corners must not be used in high voltage electrical apparatus lest the concentrated electrical stresses at these corners cause a breakdown. Stamped inserts use holes, slots and angles for anchorage. Grit blasting is used to roughen the surfaces of all inserts requiring considerable adhesion to the compound. Soap is often applied to insert surfaces to reduce sticking to those surfaces that must be cleaned after molding.

Squeeze rings are frequently used on straight sections of inserts since this ring will crush and provide a tight seal when the insert is driven into the mold insert hole. This squeeze ring should be about .015" wide and .003" to .005" thick. It will prevent the compound from flowing into the thread of the insert and will also serve to hold the insert in place when loaded in the mold plunger. Conventional male and female inserts make use of a shoulder or sealing ring to stop the compound from flowing into the inserts.

(*Continued on page* 90)

Saran Tubing at Work . . .

By L. H. Woodman
The Dow Chemical Company

Light Weight, Strength, Chemical and Electrical Resistance Enable It To Replace Metals in Many Applications

PERSONS not connected with the plastics industry, or unfamiliar with the characteristics of these materials, frequently voice the question: "Will plastics replace metals?"

Although not always specifically stated, their question usually implies *complete* replacement. To anyone having even a basic knowledge of plastics such queries are about as logical as would be the question: "Will music replace moving pictures?" The replacement of one material by another has been going on almost since the beginning of human progress—*but only insofar as the one material better meets the requirements of a particular job.* Characteristics of various materials are as myriad as the needs of man, and the replacement of one by another can never be more than a matter of degree.

In lining up Saran pipe and tubing and their metallic counterparts on opposite sides of the drawing board there are just two basic questions for consideration—cost and suitability to the job. These factors are, however, directly interrelated in that each may have a definite bearing upon the other.

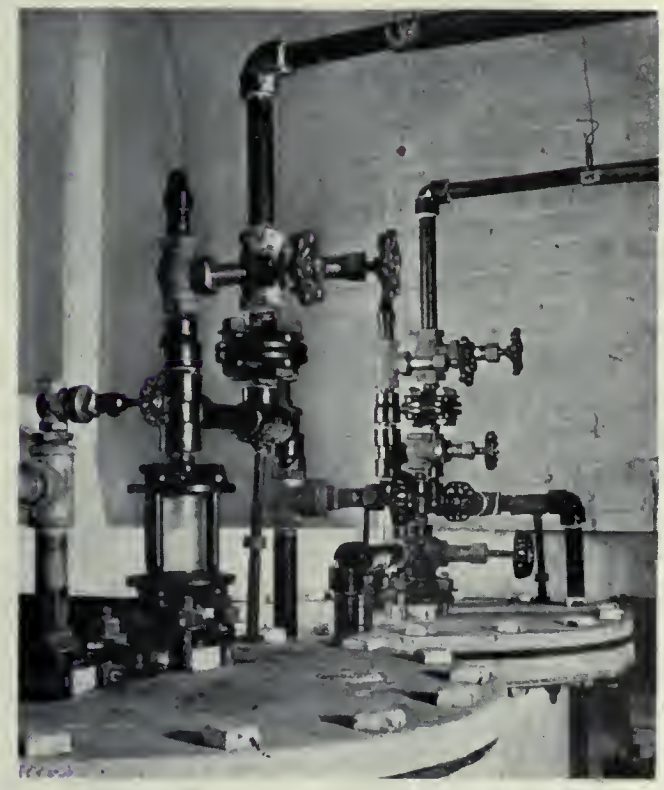
Initial cost of the material is easily computed, and just as the higher cost of copper pipe excludes it from uses where iron pipe will serve as well, so the proportionately higher cost of Saran pipe automatically excludes it from applications where its special characteristics are of no particular advantage.

Installed cost and long-term cost, however, are affected

(*Continued on page* 99)

A pocket-knife and a simple flaring device enable workmen to make new connections "almost in a matter of seconds" with any of the standard fittings

These Saran drain lines from chemical laboratory sinks replaced vitrified tile, which leaked at joints



Saran piping, tubing and fittings combine in water purification unit with metal valves and fittings

Pre-forming and Post-forming Strengthen Complex Shapes

Examples of parts made by hot-forming "Micarta 444." This is done in manner similar to that of metal. Wood or other inexpensive molds may be employed

Two grades of "Micarta 444"—the dark green (left) and light tan, the latter being better suited to deep-drawing and the forming of more intricate contours

Hot-Formed Laminates Retain Original Properties; Pre-Formed Resins Strengthened By Fibres, But Easy to Mold

TWO processes announced recently by Westinghouse Electric and Manufacturing Company promise to ease considerably the task of forming difficult shapes while retaining exceptional strength.

Hitherto, whenever manufacturers desired to produce unusual shapes, it was necessary to use moldings in which a resin was used to bond a flocculent, granular or powdery filler, such as wood flour. The material was marked by lack of strong intercontinuity of the fibres, which produced a comparatively weak and brittle plastic.

Post-forming

Known also as hot-forming, this process has produced a new material termed *Micarta 444*, a special laminated phenolic which retains unusual properties even after the forming process. Originally developed for aircraft, the plastic has been accepted for use as trim tab fairing, accumulator covers, aviators' chart cases, fuselage tailwheel housing, wing-gun ammunition feeds and ejection chutes. The process may be extended after the war to forming of parts previously drawn, formed and processed from thin metal sheets.

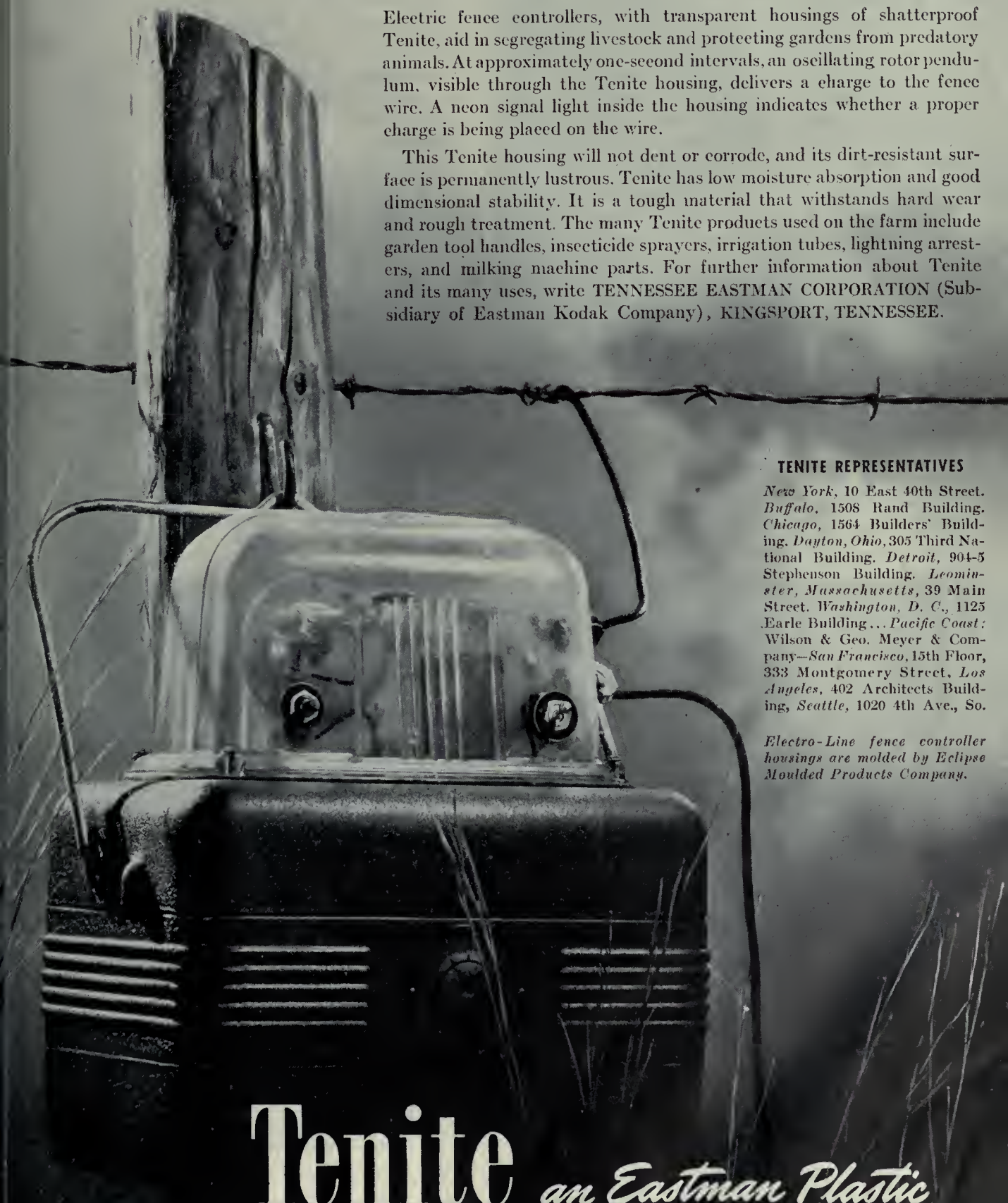
The hot-forming process, as applied to *Micarta 444*, results in the material passing through a stage of considerable flexibility when heated rapidly to a temperature of about 275° F.

When cooled to ordinary temperature, it recovers its average physical properties.

First step in the fabrication of a shape is to determine the correct forming temperature for proper bending of the flat plastic. This is done by cutting a small strip of material and placing it in the source of heat until the desired flexibility is attained. This can be done by means of parallel hot plates, oil or metal baths, hot air ovens, infra-red radiant heat and dielectric heating. Deep drawing is another characteristic essential for success in hot-forming. *Micarta 444* is distinctive in its possession of this property, surpassing even ordinary Micarta. The mold for this test is made from wood, concrete or *Micarta* itself.

Similar, but not quite as good results may be obtained with such other plastic materials as vinylite, cellulose acetate, cellulose acetate butyrate

Farmer's Friend



Electric fence controllers, with transparent housings of shatterproof Tenite, aid in segregating livestock and protecting gardens from predatory animals. At approximately one-second intervals, an oscillating rotor pendulum, visible through the Tenite housing, delivers a charge to the fence wire. A neon signal light inside the housing indicates whether a proper charge is being placed on the wire.

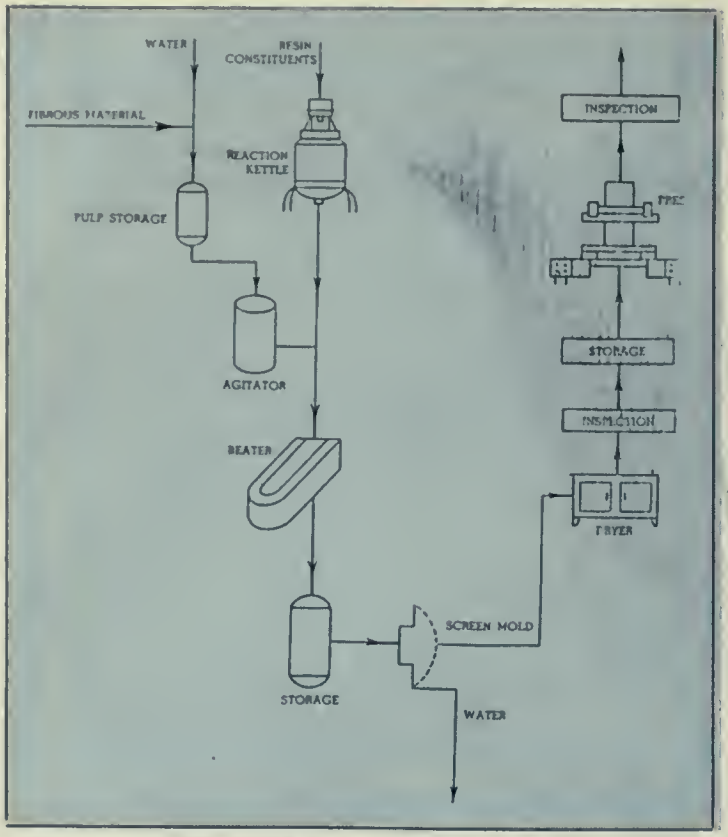
This Tenite housing will not dent or corrode, and its dirt-resistant surface is permanently lustrous. Tenite has low moisture absorption and good dimensional stability. It is a tough material that withstands hard wear and rough treatment. The many Tenite products used on the farm include garden tool handles, insecticide sprayers, irrigation tubes, lightning arresters, and milking machine parts. For further information about Tenite and its many uses, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

TENITE REPRESENTATIVES

New York, 10 East 40th Street. *Buffalo*, 1508 Rand Building. *Chicago*, 1564 Builders' Building. *Dayton, Ohio*, 305 Third National Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Massachusetts*, 39 Main Street. *Washington, D. C.*, 1125 Earle Building... *Pacific Coast:* Wilson & Geo. Meyer & Company—*San Francisco*, 15th Floor, 333 Montgomery Street, *Los Angeles*, 402 Architects Building, *Seattle*, 1020 4th Ave., So.

Electro-Line fence controller housings are molded by Eclipse Moulded Products Company.

Tenite *an Eastman Plastic*



Flow chart showing pre-forming process

and other materials. *Micarta 444* has a tensile strength up to 13,000 psi, flexural strength of 19,000 psi, compressive strength of 30,000 psi; density one-half that of alumnium; thermal conductivity of 6 x 10^{-4}; does not become as brittle as glass at temperatures below 0; maintains 85% of impact strength and gains 25% in ultimate tensile strength at —4° F; does not wilt at high temperatures, but maintains 60% of tensile and gains 50% in impact strength at 170° F, which is the softening point of the average thermoplastic. The permissible radius of bend for shapes may be as little as 1/32" for 1/32" thickness, or 3/32" for 1/16" thickness.

After cooling, the hot-formed plastic retains the same strength it possessed as a flat laminate, and its appearance remains the same. Among the many postwar uses which have been suggested are furniture, light railroad cars and automobiles.

Pre-forming

The basis of pre-forming is a screen formed into the desired shape, over which dispersed fibres suspended in water are felted out. If the fibres have been individually coated or impregnated with a suitable resin before being deposited on the screen, the felted article will in fact be a raw plastic pre-form, to be hot-molded in a press as the final step. The principal problem is to selectively attach particles of resins to fibres in an aqueous solution without undue loss of expensive materials. In some cases, it is intended that the fibres settle in layers of exactly uniform thickness; in others, there must be adjacent thick and thin sections. With the commonest of materials, such as kraft pulp fibre and a simple phenolic resin, excellent properties have been attained: Whereas laminated *Micarta* has a tensile strength of 14,000 psi; flexural strength of 20,000 psi, and impact strength of 54 in-lb, and *Moldarta* a tensile strength of 7600 psi; flexural strength of 10,000 psi and impact strength of 36 in-lb, *preformed* plastics can be produced with approximately 14,000 psi tensile strength, 18,500 psi flexural strength and 65 in-lb impact strength.

The pre-forming process follows this general pattern: Individually-dispersed textile or wood fibres are agitated in water and beaten with the resinous fluid, which impregnates each fibre. The pulpy mixture is 97-99% water by weight at this point. The mixture is sucked into a

Intricate shapes can be produced with "Micarta 444", which retains its strength after being formed

Properties of Micarta 444

Tan		Properties	Dark Green	
With Grain	Cross Grain		With Grain	Cross Grain
13,000	11,000	Tensile strength	13,000	11,000
0.9×10^6	0.9×10^6	Modulus of elasticity	1.1×10^6	1.1×10^6
10	12	Tensile elongation—% (ultimate)	9	9
19,000	16,000	Flexural strength flatwise and edgewise	24,000	18,000
2.0	2.3	Izod impact strength flatwise, ft-lb/1" width	6.0	5.0
1.3	0.7	Izod impact strength edgewise, ft-lb/1" width	3.0	2.0
33,000		Compressive strength flatwise	37,000	
16,000		Compressive strength edgewise	20,000	
240 v/mil		Dielectric strength, short time	200 v/mil	
130 v/mil		Dielectric strength, step by step	100 v/mil	
1.37		Specific gravity	1.39	
6.0		Water absorption (ASTM) 3x1x1/16 (weight gain, 24 hr)	4.5	
Approx. 0.00061 cal/ sec/°C/sq cm/cm		Thermal conductivity	Approx. 0.00061 cal/ sec/ °C/sq cm/cm	
Approx. 31×10^6 per °C.		Thermal coefficient of expansion	Approx. 31×10^6 per °C	
Approx. 0.4		Specific heat	Approx. 0.4	

NOTE: Properties are average value based on tests made by ASTM method Samples were tested in "as received" condition at approximately 70° F. *Tan grade has ultimate elongation of 40% diagonally; dark green, 25%.

copper screen mold shaped like the finished product, the piece is dried and is finally molded under pressure and heat into final condition. The fibres bolster the strength of the resin to give an excellent structural material with high tensile strengths.

The filler fibre is received in the form of paper-like sheets. After the preform has collected the fibrous pulp, it contains about 35% water by weight. The photos show a streamlined fillet for an airplane tail. The bullet-shaped pieces shown are shell-noses also fashioned experimentally from the plastic, while the glass jar contains the material in its original liquid form. Pre-formed plastics are generally one-third as strong and one-third as heavy as aluminum alloys used in aircraft, but can be made three times thicker than the aluminum alloys. Thus, for a given weight, the plastic member will be as strong in tension and compression as the aluminum alloy, while the added thickness will give the plastic three times the resistance to bending, which is important where buckling is a critical design factor. Among other war uses possible are aircraft propeller spinners.

Advantages

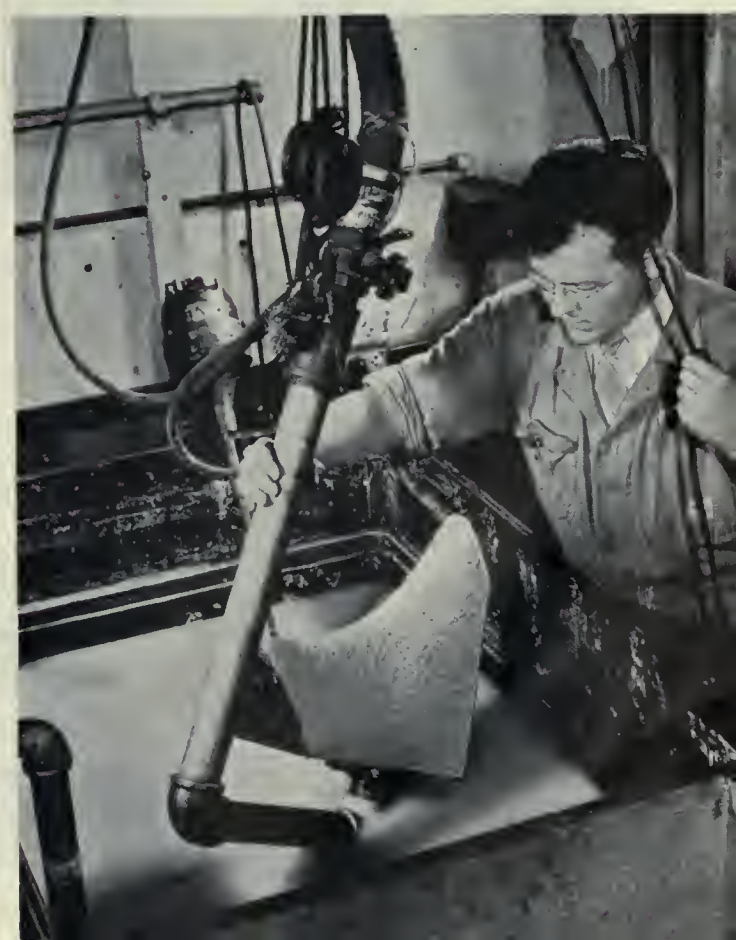
Pre-forming combines the strength of woven or felted fibres with the formability of powder molding. After the war it is likely to play an important role in replacing of lighter metals for machine parts, of powders molded into intricate plastic shapes; in radio and refrigerator cabinets, automobile doors, dashboards and other body parts; luggage, cameras, furniture, typewriter frames and filing cabinets.

How the individual fibres add strength to the plastics is illustrated by the fact that the resin itself which is used in the solution has an effective tensile strength of only some 4000 psi, whereas, an individual fibre of flax, for example, has an ultimate tensile strength of around 150,000 psi—half again as strong as all but the finest of tool steels. It is these fibres which bolster the strength of the resin in pre-formed plastics to give them their unusual tensile strengths.

Variations in the pressure applied during final molding can be utilized to produce different results, ranging from a cork-like substance to a dense, strong material resembling hardwood. END

Dr. A. Allan Bates, manager, Westinghouse Research Laboratories' chemical and metallurgical department, holds pre-formed airplane tail fillet. In foreground (right) is jar with materal in original form; left are shell noses experimentally pre-formed

Research engineer hoists copper-screen form out of plastic mixture after pump has sucked resin-impregnated wood fibres on to the form. After being dried and molded, the material becomes tough and smooth. Item is same tail fillet shown in photo above



Plastics Aid Hypochlorination

Transparency feature of methyl methacrylate in Chem-o-Feeder parts permits operator to observe movements of valves and fluid

By H. E. Hollberg

Vice-President
% Proportioneers, Inc. %

Cast Acrylics in Water Treatment Provide Pattern for Extension Throughout the Chemical Industry

THE transparency and resistance to corrosion of cast acrylics have made possible a new series of applications of this material in the chemical industry in connection with hypochlorination work.

The problem faced recently by % Proportioneers, Inc. % was to find a substitute for expensive and hard-to-machine metals such as Hastelloy and KA2SMO stainless steel. The use of these metals was further impeded by their susceptibility to corrosive action caused by the reagents used in the treatment of water and sewerage. After experimentation in plastics it was found, in addition to solving these problems, that they could be utilized to far greater extent than metals by being formed in a manner impossible to normally machine. Other quickly apparent advantages were a neater appearance and, highly important in the field of water sterilization, the ability of the operator to observe all moving parts and liquid flow.

Let us examine the heavy duty Chem-O-Feeder on the front cover. The unit shown has a drive motor cross-connected to the starting switch of a water pump, which results in feeding in strict step with the pump delivery Its "See-Thru" reagent head is made of methyl methacrylate having extreme chemical inertness, being unaffected by alkalis, oxidation agents such as chlorine and hypochlorite solutions and most inorganic acids. In fact, every chemical used in waterworks and sewerage can be handled by this material. It is also far more durable a material than its predecessors. The transparent feature of the thermoplastic makes it possible for the operator to observe the action of the diaphragm and check valves as well as the movement of the liquid being fed. Though the reagent head is furnished with either rubber hose or plastic tubing according to specification, the standard fittings are for the latter.

The reinforced diaphragm used is made of *Vinylite* copolymer plastic having a flexing life, strength and chemical resistance superior to any material formerly used for this application.

The chemical feeding rate may be selected and changed at will while the Chem-O-Feeder is in operation by simply turning the feed selection knob which is directly connected to the displacement mechanism and visual stroke length indicator. Plastics are again found on this unit in the cover which fully protects the stroke length indicator dial. A dosage calculator is printed right on this plastic cover telling how to make up solutions and how to set the feed at the proper stroke length for various pumping rates.

The chemical itself is fed in a continuous stream avoiding "shot" feeding and uneven distribution of the solution. It is able to handle a range of applications including soda ash, lime slurry, aqua ammonia, activated carbon, aluminum sulphate, sodium silicate, diluted acid, ferric chloride, Calgon and others, as well as hypochlorite solution. Duplex and Triplex Multi-Control feeders have been developed for cases where more than one chemical is to be fed at a time.

These new plastic developments are reflected in better equipment being available for chemical industry and municipal application. END

FRONT COVER

Methyl methacrylate makes its appearance this month in the "Chem-O-Feeder" manufactured by % Proportioneers, Inc. %, where it is used in the reagent head. Its imperviousness to corrosion, transparency and durability features make it ideal for work in the chemical field, particularly in hypochlorination.

New Bit Life in 60 Seconds

AGAIN, and AGAIN, and AGAIN this one-minute operation will restore the CLUTCH HEAD Type "A" Bit to its original efficiency. Contrast the elimination of cost and delay attained by this simple application of the end surface to a grinding wheel . . . as against the expense and bother of "back-to-the-factory" shipment of bits for reconditioning. Consider also, the rugged structure of this Type "A" Bit . . . a factor that enables it to deliver *a longer uninterrupted spell of service* on the Line between reconditioning grindings. The definitely longer total life of CLUTCH HEAD Type "A" Drivers is an economy item that has a direct bearing on final production costs.

CLUTCH HEAD offers seven major features that contribute to faster, safer, and lower-cost production and service. You may examine and test these features right at your own desk. Ask us *to mail* you sample of this Type "A" Bit along with package assortment of CLUTCH HEAD Screws and illustrated Brochure. You will discover why CLUTCH HEAD is The Screw That Sells Itself.

This is the *only* modern screw that may be operated with the ordinary type screwdriver; even with a piece of flattened steel rod in emergency . . . so important in simplifying field problems in war and peacetime service.

CLUTCH HEAD SCREWS

Note the straight-walled Clutch matched by the straight sides of the Driver. No tapered entry to create ride-out tendency. No end pressure required. This means elimination of fatigue factor for sustained high production.

UNITED SCREW AND BOLT CORPORATION

CHICAGO CLEVELAND NEW YORK

LUMINESCENCE
Present and Future

In daytime, decorative items such as these, made with phosphorescent-pigmented plastics, are activated by light

By M. A. Heikkila

Market Development Division
The New Jersey Zinc Company

WIDESPREAD and increasing use of luminescent pigments with plastics for war purposes has stimulated great interest in the post-war development of this trend. Interest is not limited to the pre-war novelty field, but also extends to numerous phases of everyday civilian life.

In war, luminescent pigments are used as low-intensity light sources to provide: (1) improved night visibility, and (2) emergency illumination in the event of a blackout or power failure.

There are two general types of luminescent pigments: Fluorescent and phosphorescent. The fluorescent emit light only during the time of excitation by an ultraviolet or "black" light, and have no useful afterglow.

Phosphorescent pigments continue to emit light for a period of time from a few minutes to several hours after the exciting light is removed. These pigments may be activated by any light source if used only for their afterglow properties.

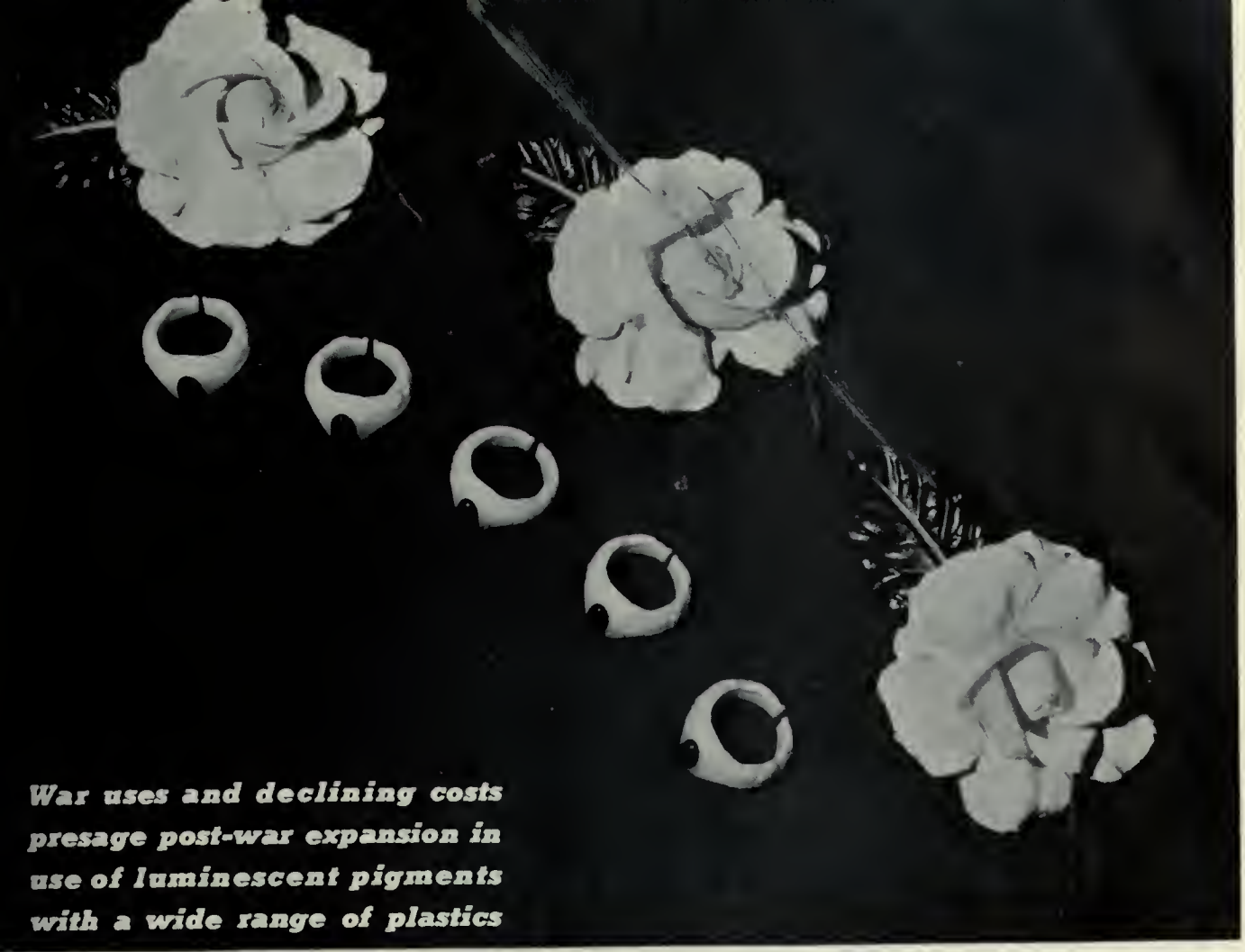
Eighteen grades and color types ranging from violet to red have been developed. These colors are non-toxic, containing no radioactive salts, and are produced and used on a tonnage scale. Prices have been reduced 80-95% from the prewar price range to the present cost.

Luminescent pigments are used in clear and translucent plastics, are printed on opaque plastics, in paints and lacquers, on coated and filled papers, in coated and printed textiles, in decalcomanias and in printing inks. Synthetic resins are generally best as the vehicle for use with paints, inks and other coatings.

For visibility at night, luminescent pigments are used with ultraviolet or "black" light. Aviation equipment (dials, instrument instruction and identification plates, navigational maps, charts and computers, and directional and identification markers), which use luminescence extensively, are visible to and usable by dark-adapted eyes. And —of vital importance—the dark adaptation of the eye is not affected by the luminescence. When the gaze is shifted from the non-glaring "glow" of the instruments and other equipment to the dark surroundings, night visibility is not destroyed as would be the case if the eyes were exposed to the glare of conventional illumination. Besides, at the low intensities utilized for war purposes, the luminescence is visible only a very short distance, thus precluding detection by the enemy.

Plastics Used Extensively

In many of the war applications, the pigment is incorporated into the plastic resin prior to molding, casting, lamination or fabrication. For other uses, the desired markings are made luminescent by printing with suitable inks on the finished plastic, or by coating the surface of the plastic with the pigment and printing over this surface



War uses and declining costs presage post-war expansion in use of luminescent pigments with a wide range of plastics

At night the full beauty of phosphorescence becomes visible as the pigment emits its characteristic afterglow

with a positive plate, which results in a reverse effect.

If the luminescent pigment is introduced directly into the plastic, a transparent or translucent plastic is of course, required to permit luminescence of sufficient intensity to be used. When one of the printing or coating processes is utilized to imprint the luminescence, any surface suitable for printing, including plastics can be used.

Markings on such items as instrument panel dials and navigational computers are usually printed by the silk screen, letterpress decalcomania or "bronzing" (dusting) methods, with synthetic resins as the vehicles for the luminescent pigment (Fig. 2). Most instruction plates generally are prepared by coating the surface of the plate with phosphorescent pigments (in synthetic resin vehicle), and then screening the phosphorescence in areas where it is undesired by printing with a positive plate, using non-luminescent printing inks.

Signs and markers are produced either by printing or coating, or by painting the sign on the face of luminescent plastics (Fig. 3). Textiles, when used as directional signs or markers, are coated with phosphorescent pigments (in synthetic resin vehicles), and any required information is printed on the luminescent surface.

Phosphorescence for Emergency Light

Quite often it is necessary to carry on activities during a blackout or power failure without the aid of visible lights. Under such conditions, phosphorescent pigments in the form of pigmented fabrics are used as emergency light sources.

Luminescence Post-war

When considered from the standpoint of wartime experience with luminescence, the increased productive capacity and greatly reduced costs, peacetime applications for luminescent pigments appear practical and economical. What all of these post-war uses will be is difficult to predict. However, a number of practical applications in connection with plastics appear self-evident.

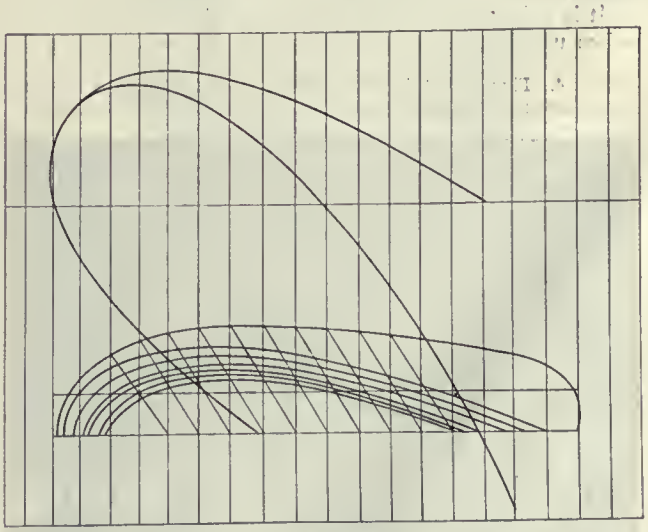


Fig. 1. Contact-printing phosphorescent-sentitized plate from above phosphorescent drawing makes master negative template

Fig. 2. Fluorescent dials in dark under ultraviolet light

Fig. 3. Signs made with luminescent-pigmented plastics

Architectural Uses

Uses indicated in the architectural field include luminescent decoration and design, ornaments, directional and identification signs and markers (Fig. 3). These decorative effects may be obtained in a number of ways: painted or printed murals or simple designs, in ornaments, and on draperies, upholstery or floor and wall coverings. Luminescent plastics, and synthetic resins as vehicles for luminescent paints and printing inks, undoubtedly will play an important part in this field.

The use of luminescent decorations will find immediate application where darkness or semi-darkness prevails in the home (television receivers or home-movie projection rooms, as illustrated in Fig. 4), and in public buildings (theatres, cocktail lounges, etc.).

Uses in Industry

Industry will be interested in luminescent dials and instruments (Fig. 2), signs and markers, identification buttons, safety warnings, advertising billboards, displays, trade-names and product name plates, packages and labels, and advertising novelties.

It is quite possible that fluorescent dials and instruments, when used with the new mercury-arc, fluorescent or other types of lighting which emit a high percentage of ultraviolet light, will be brighter and more visible. Identification buttons, badges or cards, when printed with luminescent inks on luminescent paper or in plastics, will offer an additional measure of protection against forgery. Phosphorescent signs, markers and safety warnings, as well as phosphorescent dials, act as emergency light sources in the event of a power failure, permitting easy idenfication and location of vital equipment, and safe movement in the dark. In the field of advertising, luminescent pigments offer many unusual and dramatic ways for display of sales messages.

Another application of interest to industry is the use of phosphorescent pigments as the light source in the contact-printing of photo-templates. (Fig. 1). In this process, a metal, plastic, or wood surface is coated with a plastic resin, generally cellulose acetate pigmented with a suitable phosphorescent pigment. The surface is lightly rubbed to take drawings. After the phosphorescent drawing is excited by exposure to a light source, a master plate is made by contact-printing methods. Any number of pattern plates can be made from the master plate since it also is phosphorescent, assuring accuracy of reproduction, and eliminating the necessity for expensive camera equipment.

Many products going into the home or used by the general consumer may be wholly or partly luminescent, such as radio and television dials and control knobs, furniture trim and upholstery, draperies, wall and floor coverings, product name plates on electrical equipment and other household items, telephones, ash trays and dresser sets. Signs and markers, stairway risers and railings, switch plates, lamp shade and bases, mirror frames and other items, if phosphorescent, permit safe movement in the darkness.

Some of these uses are decorative only, while other items are both decorative and utilitarian in that they not only add some color and decorative design to the home but at the same time act as low-intensity light sources for use as guides in the dark.

Other and probably more interesting and useful applications will be developed by the plastic manufacturer or processor after he becomes acquainted with the properties and limitations of these colorful luminescent pigments through trial and test. END

Fig. 4. Fluorescent home furnishings provide enough light for movement in dark but do not interfere with television

A CINCH FOR US!

A *Cinch* FOR YOU

In the designing room of CINCH many of radio's most serviceable features, represented by small metal plastic parts, were "born". Here you MEET MEtal Plastics Engineering "at tops" at the start. And when having expressed the need, you watch it supplied, following thru from its inception, visualized on the drawing board, on through the many phases of modern manufacturing, you know that what is "A Cinch for us" must result in "A CINCH for you". For example: the Diheptal socket in communications. CINCH offers a complete metal plastic service for small and intricate assemblies.

CINCH MANUFACTURING CORPORATION

2335 WEST VAN BUREN STREET • CHICAGO 12, ILLINOIS

SUBSIDIARY OF UNITED-CARR FASTENER CORPORATION · CAMBRIDGE, MASS.

No. 2 of a Series of Advertisements: "MEET MEtal Plastics Engineering"

At night the plastics sign (above) is not appreciably distorted when seen from an angle, while in broad daylight, viewed head-on (left), it is as clear as it was designed to be

The lettering on the neon type of sign is badly distorted when viewed from an angle at night (above) and it is even marred by reflections in a head-on view by daylight (right)

Colored Laminates for Display Purposes

Translucent Lettering in Color, When Illuminated From Behind, Presents Attractive Signs Without Neon Distortion

"BUILT-IN color" in laminated plastic is now an accomplished fact on a commercially practical basis. By a perfected process, opaque and translucent areas can be incorporated into the same laminated sheet in the pressing or "cooking" process so as to become an integral and homogeneous part of the sheet itself.

This new development has unlimited possibilities particularly in the sign industry: for commercial displays, for road signs and markers, for illuminated advertising, and for indirect lighting with decorative effects.

Faithful reproductions of stylized lettering and illustrations, with microscopic detail, are possible in black and white or in full color. When translucent areas are used for the lettering, the laminated sheet can be lighted from behind to make possibly the most readable sign yet devised.

With either ordinary electric bulbs or cold cathode tubes, the effect of a neon tube sign can be simulated in any color with many advantages over the former glass tubing application. Whereas the neon signs necessitated the use of transformers and became unsightly with broken tubes, the plastic panel has none of these disadvantages. Furthermore, there is no unreadable distortion in the plastic sign when viewed from an angle and it presents a clear attractive message in the daylight as against the lighted tubes which become confused at any angle other than head-on and which are useless in the daylight to a very great extent.

The new plastic signs offer both an extremely low initial cost and reduced costs all along the way. Shipping and erection costs are low because of the lightweight and unbreakable qualities, expensive service calls are eliminated because there is no fragile glass to shatter, no repainting or maintenance necessary, and the cost of electric current for lighting has been reduced to the minimum.

There are other applications for this patented process for laminating different colored plastics. Automobile license plates so made could be full weatherproof and clearly visible by day. If snapped like a watch crystal into a bezel recessed into the back deck of a car, the tag could be illuminated by a bulb that also lights the rear compartment. In this manner the license plate will not destroy the airflow of a streamlined car.

Manufacturers will undoubtedly find other uses for the precision placing of varicolored plastics together in one completely fused panel. This new development by the Halo Display Products Corporation, Philadelphia, Pa., opens the door to many new applications for plastics. END

RAINWEAR for soldiers . . . or WATERPROOFED FABRICS for the younger generation

There are practically no limits to the versatility of our fabric coating facilities.

Today our plants are turning out millions of yards of heavy duty fabrics, uniformly proofed against water and many other fabric destroying elements.

Tomorrow's production may be yards of soft, non-allergic cottons for sanitary sheetings or baby clothes —or thousands of yards of tough, swanky simulated leather upholsteries—or simply waterproofing, with clear filmy plastics, dainty curtain materials for a lady's shower.

You as a manufacturer may or may not be interested in these particular end uses—yet they are but a few of the future applications for plastic coated fabrics in consumer goods and industry.

Although much of our production is still restricted to military and essential civilian uses, the time may not be far distant when it can be safely diverted into domestic and industrial channels.

Plastic coatings are here to stay. For hundreds of applications they have been found superior to the protective materials for which they were substituted after Pearl Harbor.

If your future manufacturing plans call for fabrics or paper "proofed" against such destructive elements as acids, alkalies, oils, gases, water and many others we would welcome the opportunity of supplying your requirements.

Samples of our current production of plastic coated fabrics and papers are available for your inspection.

Joanna Coated Fabrics

PLASTIC FABRICS DIVISION

The Western Shade Cloth Company, 22nd & Jefferson Streets, Chicago 16

Plastic Fabrics Division: VINYL RESIN, PYROXYLIN AND OTHER PLASTIC COATINGS • PROOFED FABRICS AND PAPERS • SIMULATED LEATHERS
Industrial Fabrics Division: RUBBER HOLLANDS • VARNISHED SEPARATOR CLOTH • BOOK CLOTHS • AND OTHER SPECIALIZED FABRICS
Window Shade Division: WINDOW SHADE CLOTH, ROLLERS AND ACCESSORIES • CLOTH AND PAPER WINDOW SHADES

JOANNA TEXTILE MILLS, GOLDVILLE, SOUTH CAROLINA

Serving tray exemplifying the trend in popular transparent home furnishings

Distinctive Designs in Transparent Furniture

By Lenard Scheff
President, Industrial Arts, Inc.

Unprecedented Sizes, Removable Upholstery, Mass Production Are Promised for the Post-War Period

WHEN war broke out, the fabrication of furniture from transparent plastics was still in an experimental stage. Many problems of manufacture, design and maintenance had yet to be worked out, and there was little experience over periods of time on which to base judgments as to the suitability of existing models. Production was still largely a matter of job-lot handicraft.

Today, thanks to experience gained through the war years, the knowledge of how early models have stood up over periods of time, and the development of new techniques and materials, the end of the war will bring an immediate switch-over to full-scale fabrication of attractive, durable home furnishings, including such items as coffee and bridge tables, beds, chairs of all kinds, what-not shelves, ash trays with stands, end tables, cocktail and other serving trays, picture frames, ventilator grilles, staircases, lighting fixtures, lamps, artificial plants, desks, bars and even entire walls.

The appeal of this type of furnishing to the public is obvious—the delicate grace of transparency, the intricacy of compound shapes, durability, extremely light weight, ease of cleaning, and reduced price as the volume of production increases and the cost of materials declines with the end of the war. Production techniques have been developed within the last 2 years which make possible the fabrication of transparent furniture on a mass scale and permit the making of furniture in sizes hitherto considered impracticable. Occasional tables have been produced 36" in diameter and 30" high. Chairs can be made out of a single plastic sheet. Chairs and couches can be produced with upholstered inserts which can be removed in order to clean both the inserts and the plastic. New methods of deep drawing open an immense field for lighting fixtures and large objects. Hemispheres of accurate and uniform shape can be produced with diameters of 40". Many irregular shapes can likewise be made, using both vacuum and autoclaves, separately and combined. Drawings have been received calling for entire radio cabinets formed in one piece entirely of transparent plastic, with a rather unique method of concealing those parts and mechanisms which should not be seen. END

ffee or cocktail table which has proven not
ly attractive, but useful and sturdy though
ht in weight. Tabletop diameters up to 30"
ve been made; optimum height is usually 17"

touch of finesse is added to the office by
ansparent plastics furnishings, which in-
ude the globe made of two perfectly-formed
emispheres having high dimensional stability

CLEAR AND COLORFUL DESIGN IN CELLULOSICS COMES INTO THE MODERN BOUDOIR

Cellulosics

Offer Versatility with Strength

By Dr. Marie Bentivoglio
Research Chemist, Plastics Division
Celanese Corporation of America

Clear, Colorable and Economical, They Comprise Bulk of Rigid Thermoplastics

ACCORDING to a recent estimate for 1943 prepared by Dr. R. H. Ball, assistant technical director of the Development and Research Department of the Celanese Corporation of America, Plastics Division, the cellulosic plastics make up about 60 to 65% of the national output for rigid thermoplastic materials and about 30% of the estimated 255 to 280 millions of pounds produced of rigid plastic materials. These cellulosics include cellulose nitrate, cellulose acetate, cellulose acetate butyrate, high acetyl and ethyl cellulose and they are fabricated into sheets, rods, tubes, film foils, and molding materials. Thus the importance of the cellulosic group of plastics can be appreciated.

Historically, the cellulosics are the most interesting group of plastics for they include cellulose nitrate plastic or celluloid, the first plastic, discovered in 1868, and each year since has brought with it some interesting development or the addition of a new (*Continued on Page 62*)

The future of cellulosics looms large among toys, dishes and other objects about the home.

Three lightweight sports toys designed by Egmont Arens for low-pressure molding with reinforced plastics. The kayak and ice-boat can be easily assembled from a model kit of prefabricated parts

Durable TOYS from Reinforced Plastics

By Egmont Arens

Well-known New York industrial designer, the author has developed plans for a variety of molded plastics products, including furniture, luggage, boats and automobile parts. He experiments in his studio with plywoods, laminated and felted fibres; believes that low pressure molding has a great future.

The author with a small autoclave he has set up in his studio for research

Low-Pressure Molding of Reinforced Plastics Promises to Extend Their Use to a Wide Range of Children's Playthings

JUST as injection-molded plastics stole the show in the small toy field a few years ago, so now the technique of low-pressure molding of reinforced plastics bids for domination of post-war markets in larger toys, sporting goods and similar items as soon as materials are released for civilian consumption.

Most of the thermoplastic and thermosetting resins (the latter usually extended with wood flour and other fillers) which are successfully used for small molded toys are too fragile for larger toys such as scooters, wagons, streamlined sleds, toboggans and skis. Now, by introducing long fibres, vegetable or synthetic, into the molding compound, we get a product that has amazing strength characteristics. These fibres reinforce the resin in the same way that steel rods reinforce concrete. Naturally these long fibres are unsuitable for injection molding, as they would clog up the gates in no time. Therefore, new techniques had to be developed.

As soon as we started thinking about large area moldings, there was another item that immediately became very important. That was the cost of the molds. Anyone acquainted with the cost of steel molds for injection molding will realize that molds 10 to 20 times as big—the mold for a toy auto, for instance—would run into astronomical figures as compared with the cost of molds made for steel stampings in the automobile industry. That kind of mold is not suited to the comparatively small production runs in the toy business.

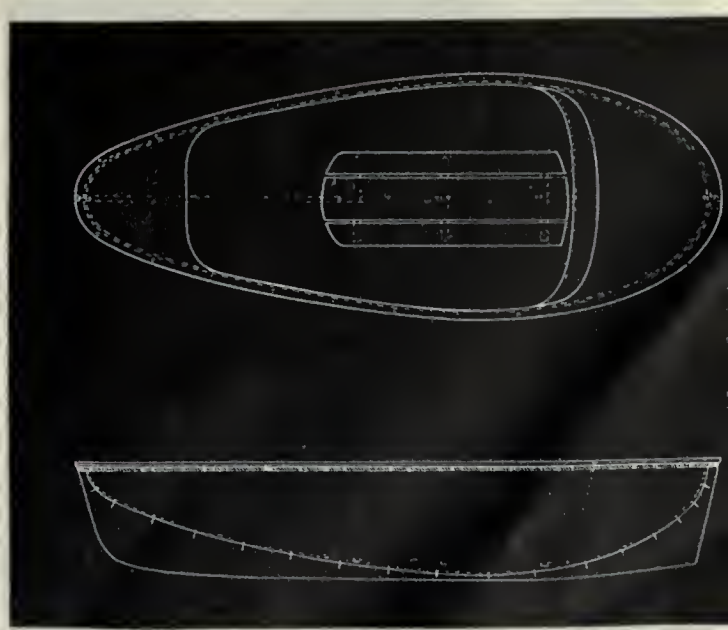
Materials for Molds

New techniques finally evolved have brought mold costs down to such low figures that they no longer are an important item in the manufacturing picture. In some cases the cost of the mold is no more than the cost of a wood pattern for metal castings. Molds or dies may be made from such inexpensive materials as wood, cast iron, cast aluminum, concrete, *Toolite* and other plastics, *Formrite, Kirksite, Masonite,* and even plaster of Paris. Naturally these less expensive dies, which can be mocked up in anybody's back yard, will not stand the high pressures that steel dies will. So in hundreds of laboratories devoted to war work a solution was sought. It was found in low-pressure molding.

Low-pressure molding includes operations that run all the way from no pressure at all up to several hundred pounds, as contrasted to high-pressure molding, which runs into the thousands of pounds.

Molders are finding remarkable answers in operations, some as simple as dipping a piece of cloth in a plastics solution, and draping the cloth over a plaster mold, apply-

(*Continued on page* 88)



Drawings by author for "Co-Ro-Lite" kiddie boat a child could build using molded shells and other pre-cut parts

Plastics and Metals: Comparative Production Costs

By W. I. Beach

Chief Plastics Engineer, North American Aviation, Inc.

Estimating Department of a Major Aircraft Manufacturer Shows Savings in Most Replacements of Metals by Plastics

FREQUENTLY in the past, when attempts have been made to employ plastics in specific applications without giving adequate consideration to structural integrity, functional efficiency or economy of production, the results have been discouraging to say the least. This malfunctioning of plastics brought down a shower of criticism upon the plastic field as a whole, without providing an opportunity for the presentation of true facts to modify the adverse impression created by promiscuous utilization of the inferior plastics. Nevertheless, in the face of this initial handicap, plastic engineers have applied themselves diligently to the task of correcting erroneous impressions, conducting useful testing programs and compiling constructive design criteria.

Like other materials, plastics must be subject to certain compromises. Although considered low in strength, plastics materials possess a low specific gravity which tends to compensate for their average strength, resulting in a reason for a favorable strength-to-weight ratio. By ordinary standards, plastics, particularly the thermosetting types, are generally looked upon as hard and brittle substances which offer poor resistance to impact loads and riveting pressures. Yet the surface hardness of these products have much to do with their abrasion resistance properties, often desirable in many applications.

Plastics cause some concern to aircraft engineers because of a slight tendency to absorb moisture. On the other hand, they possess excellent corrosion resisting properties seldom found in other types of materials. These and several more comprise some of the advantages and disadvantages inherent in various members of the plastic family. Honest acknowledgment of limiting factors prepare the engineer to make judicious applications with either the thermosetting or thermoplastic types with reasonable safety. Accordingly, it has been ascertained that the most useful field for plastics lie in non-structural and in some instances, semi-structural aircraft parts.

Control column guard assembly. (Top, metal; plastic, below)

It is extremely difficult to present truly fair comparisons between the cost data of relative products. Costs and sales estimating methods vary with the individual molders. Also, factors influencing the market price of any given item produced by one organization may or may not be as exacting in another. By the same reasoning it cannot be said that a molded plastic part will always cost more or less than aluminum casting. If the material requirements and design conditions are better suited to molding equipment than any one of the metal casting methods, favorable costs may be expected of plastics. Tools and machinery naturally play an important part in the production of commodities. Conditions surrounding labor and overhead may be the means for the difference between the costs of two or more related products. Whatever the circumstances may be, no attempt is made to justify or defend the cost figures presented here.

The comparative data shown in Col. 15 of Table 1 represents actual values taken from purchasing records. The cost breakdown of material and labor were provided in some cases by the manufacturers of these items. When it was not possible to obtain breakdown information, which occurred with some parts, an estimated evaluation was made based upon experience gained from prior articles in the same class (in any event, the total costs and unit costs are true and not estimated).

At this point, further explanation of total costs are needed for clarification. For example, parts are frequently designed with complementary components which may be impracticable to incorporate in the as cast or molded state. Drilling of holes, tapping and machining are some operations necessary to prepare parts for production. part of this may be done by the subcontractor, but as a

DRUMS ALONG THE MOHAWK

Through regions that once resounded with the war drums of the "first Americans", move the war drums of today. They are silent drums. Yet within them is power that can be heard on every continent, and their signal to the world is the roar of planes and the thunder of tanks.

America guards her war drums well. They are made of steel, to give them strength. And to preserve their contents — to prevent seepage and spoilage — they are *hermetically sealed.*

When a drum is hermetically sealed it is water-tight and dust-proof. It can be left in open storage, or exposed to rain, or rolled through water, without seepage. It can be transported any distance — under any conditions — and arrive with every drop "as shipped". It is equipped to serve — on the home front as well as every war front — as a war drum should.

Tri-Sure Closures have a seal, plug and flange that are perfectly air-tight, water-tight and dust-proof. If a drum is equipped with Tri-Sure Closures it is hermetically sealed—*and if it's hermetically sealed it's* safe.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

Tri-Sure
Reg. U. S. Pat. Off.
CLOSURES

Table 1—Cost Analysis of Plastic and Metal Counterparts

(1) Part	(2) Material	(3) Type	(4) Weight (Lb.)	(5) Pattern or Die ($)	Cost Breakdown ($) (6) Core	(7) Molding and Casting	(8) Mat'l Cost	(9) Finish and Cleaning	(10) Heat Treat	(11) Sand Blast	(12) Rejection and Waste	(13) Machining	(14) Component Parts	(15) Unit Cost	(16) Total Cost *
Ammunition Roller (.50 Cal.)	AB	IM	.0837	1650	———	.042	.046	.034	———	———	———	———	.158	.122	.28
	AL[1]	DC	.10	965	———	.088	.036	.175	———	———	———	———	.158	.299	.457
Trim Tab Operating Drum	CFP	CM	.19	2250 (4 Cavity)	———	.200	.090	.111	———	———	.040	———	———	.441	.441
	AL[1]	DC	.20	975 (2 Covity)	———	.293	.072	.435	———	———	———	———	———	.80	.80
Elevator and Trim Tab Control Wheel Assembly	CFP	CM	.319	1375	———	.48	.137	.20	———	———	.05	.06	.35	.867	1.22
	AL[1]	DC	.40	745	———	.32	.144	.405	———	———	———	.94	———	.869	1.80
Escape Hatch Handle	MP	CM	.088	1160 (2 Covity)	———	.15	.048	.0375	———	———	———	.009	———	.235	.244
	AL[1]	DC	.12	795 (2 Covity)	———	.073	.043	.070	———	———	———	.055	———	.186	.241
	CFLP	CM	.12	590	———	.132	.054	.010	———	———	.010	———	———	.206	.206
Heating and Ventiloting System Cold Air Control Sector	AB	IM	.10	1250	———	.025	.073	.022	———	———	———	———	———	.12	.12
	AL[1]	DC	.14	995	———	.088	.050	.18	———	———	———	———	———	.318	.318
Fuel Cell Support	CP	CM	.117	650 (4 Cavity)	———	.092	.050	.041	———	———	.022	.04	———	.205	.245
	AL[2]	PSCM	.17	120 (3 Cavity)	.08	.12	.026	.020	.020	.0085	———	.52	———	.275	.79
Self-Sealing Fuel Cell Flange	CP	CM	.59	1700	———	.53	.20	.186	———	———	.08	.15	———	.996	1.146
	AB	CM	.59	1700	———	.55	.358	.08	———	———	———	.02	———	.988	1.008
	AL[2]	SC	1.40	160	.514	.36	.210	.288	.140	.028	———	4.44	———	1.54	5.98
Fuel Cell Gage Support Flange	MP	CM	.88	2000	———	.73	.299	.27	———	———	.07	.18	1.12	1.359	2.659
	AB	CM	.84	2000	———	.79	.508	.04	———	———	———	.09	1.12	1.338	2.58
	AL[2]	SC	1.750	264	.776	.36	.263	.20	.175	.035	———	4.78	———	1.81	6.59
Bomb Rack Housing Assembly	MP	CM	7.13	4000	———	3.00	6.65	4.00	———	———	———	6.35	———	13.65	20.00
	Mg	SC	9.64	450	6.88	3.50	2.70	3.30	2.30	.48	1.94	19.47	———	21.40	39.75
Carburetor Air Duct Edge	FCG	LPL	2.50	647	———	12.05	5.90	.55	———	———	2.00	3.50	———	18.50	24.00
	Mg	SC	4.70	450	4.50	2.50	10.48	.60	.56	.25	.60	11.26	———	19.89	31.75
	Mg	PM	4.70	11000	———	.85	10.48	.40	.56	.25	.30	1.52	———	12.54	14.36
Fuel Transfer Valve Diol	AB	IM	.052	1000	———	.035	.031	.050	———	———	———	———	.04	.116	.155
	AL[1]	DC	.104	950	———	.085	.025	.10	———	———	———	———	.04	.210	.250

AB—Acetate Butyrate
AL[1]—Aluminum 13 (AN-QQ-A-366)
CFP—Cord Filled Phenolic
* Total of Cols. 6 through 14
MP—Macerated Phenolic
CFLP—Cotton Flock Phenolic
CP—Cord Phenolic
AL[2]—Aluminum 356T6
Mg—Magnesium
FCG—Fabric, Canvas and Glass
IM—Injection Molded
DC—Die Casting
CM—Compression Molded
PSCM—Permanent sand casting molded
SC—Sand Casting
LPL—Low-Pressure Laminated
PM—Permanent Mold

rule the bulk of this work is the responsibility of the prime contractor or consumer. The additional costs involved in these operations along with the purchasing cost make up the total cost.

Looking at the picture as a whole, some interesting observations may be made. In those applications in which plastics performed equally as well as corresponding metal products, it was found that they averaged $3.61 per lb as compared to $3.52 for metal counterparts. On an equal pound basis, plastics cost approximately 2.5% more than metal. However, since one of the advantages offered by the resinous materials is a definite saving of weight, this difference is greater than appears on the surface. Of several hundred molded plastic parts installed in the B-25 *Mitchell* and P-51 *Mustang*, a weight saving of 4% was achieved over that of the same number of metal parts of similar design. Considering the difference in weight of the same number of parts, plastics accounted for an average cost saving of 44%.

Table 2—Cost Comparison—Control Column Guard Assembly*

Aluminum Operation	Labor Hours	Phenolic Operation	Labor Hours
Shear	0.01	**Shear**	0.01
Drill tool and pilot holes	0.03	**Drill tool and pilot holes**	0.03
a. Load and place template		a. Load and place template	
b. Drill		b. Drill	
c. Unload		c. Unload	
Profile	0.04	**Profile**	0.04
a. Load and place template		a. Load and place template	
b. Route		b. Route	
c. Unload		c. Unload	
Hydro-Press form	0.03	**Forming**	0.05
a. Set on die		a. Place in oven	
b. Form		b. Heat	
c. Unload		c. Place in die	
		d. Form	
		e. Remove	
		f. Clean	
Hand form	0.17	(See d above)	
Drill	0.02	**Drill**	0.02
a. Load jig		a. Load jig	
b. Spot jig		b. Spot jig	
c. Drill		c. Drill	
d. Unload and clean		d. Unload and clean	
Total	0.31	Total	0.15

	Labor Hours	Labor	Material	Total	Savings (%)
Aluminum	0.31	$0.85	$0.19	$1.04	
Phenolic sheet	0.15	0.45	0.16	0.61	41.3

*Teble applies to parts shown on page 40.

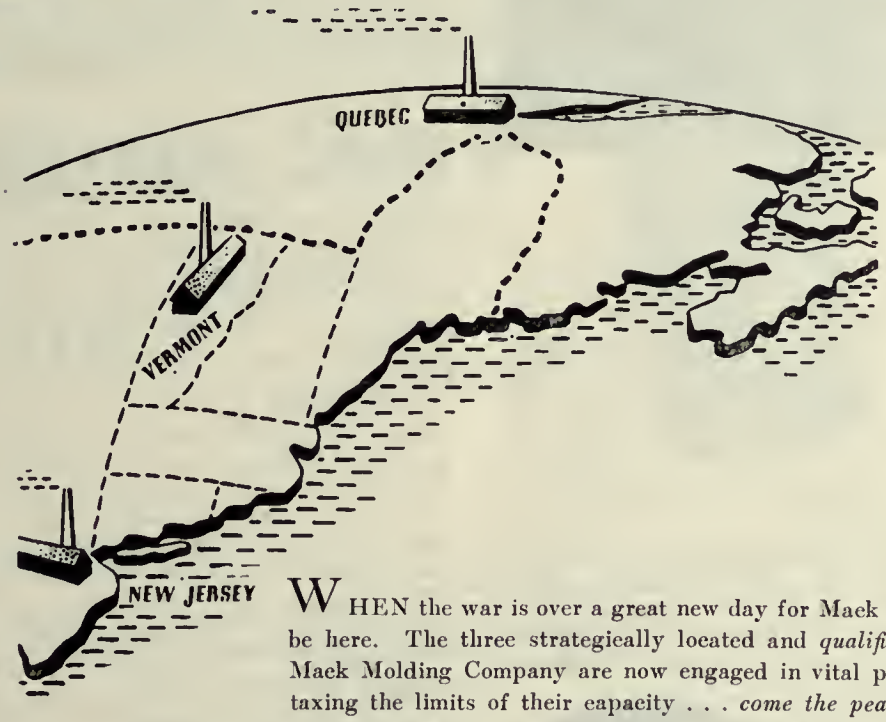
In order to compare plastic forming with metal forming, a complete cost breakdown of a production part is given in Table 2. The part illustrated on page 40 represents a comparable plastic and metal object formed to the same shape.

Of all plastic parts used in aircraft production, the .50 caliber ammunition roller (shown on page 44) has been produced in the largest quantity. Since 1942 there have been approximately 20,000 of these rollers installed in ammunition boxes and feed chutes. Prior to this change, aluminum die castings served in the same application.

The plastic roller consisting of acetate butyrate, commonly called Tenite II, is produced by the injection molding process. The metal roller is die cast from aluminum 13, ANQQA36 alloy. While both processes employ steel dies, it is noted in Col. 5 Table 1, that the plastic die cost is $1650, whereas the metal casting die cost $965. The discrepancy in die costs between the two processes depends most upon the coring and drawing operations and vary with the complexity of the part. When the contract is limited, the die cost amortized over a small number of parts adds appreciably to the unit price. In the case of the ammunition roller, however, the die cost is insignificant as compared to the unit piece price.

As for the relative time required to produce the roller,

3 PLANTS TO SERVE YOU...



WHEN the war is over a great new day for Mack Molding Co. will be here. The three strategically located and *qualified* plants of the Mack Molding Company are now engaged in vital production that is taxing the limits of their capacity . . . *come the peace* . . . the great pool of knowledge and experience we have gained will be extended to you for the solution of your plastic molding problems.

If our present war production is a barometer, many plastic problems will be problems no longer. Again Mack Molding will be producing for you in limitless quantities . . . quickly, efficiently, and economically. Your inquiries concerning vital production now, or peace-time planning, are invited. Sales offices in principal cities.

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A .50 caliber ammunition roller and installation

judging from the difference shown in Col. 7, Table 1, and assuming labor rates and machine charges to be nearly the same, the injection process would appear to require less time. According to data furnished by the molder, the injection machine operating at three shots every 2 min, parts are ejected from a two-cavity die every 40 sec. At 45c per lb, acetate butyrate is considerably more expensive in this application than is the aluminum alloy which costs approximately 36c per lb. Thermoplastic materials vary in cost with the formulations specified for each part. Therefore, the material costs are seldom constant.

The finishing and cleaning operations, Col. 9, Table 1, necessary to remove flash and gates favor the injection process. One of the primary reasons why die costs are greater in the case of plastic molding may be found in the design and construction of the die. Injection parts have little excess material in the form of flash or gates to remove. Usually the gates are small and can be clipped clean by ordinary hand shears. By and large, die castings have a large proportion of excess material to remove. This must be done by sawing, filing or sanding. Col. 16 lists the total costs of a plastic roller as compared with that of an aluminum die casting.

At the top of the photo shown below are two versions of a trim tab cable drum. One is made of a phenolic cord filler material (right); the other is an aluminum alloy die casting.

The thermosetting molding compound specified for the plastic part can only be processed by compression or transfer molding. Of the two, the latter is by far the faster method. Until transfer molding made its appearance several years ago, thermosetting molding was done by the compression system entirely. In this case, the drum is compression molded in a four cavity die. Normally, production quantities seldom warrant a die with more than two cavities. However, since seven drums per airplane are used in the control system, a multi-cavity die is necessary to maintain the schedule set up for these parts.

The aluminum die casting is produced in a two-cavity die. For the same schedule, as many, or probably more, metal parts can be cast in the two-cavity die than can be obtained out of the four cavity compression die. The molding and casting charges, Col. 7, are close, indicating comparable production in both cases. However, the die cost, Col. 5, is approximately two and one-half times greater for a plastic molded part than for an aluminum part. It is estimated that at least 4000 planes will require this particular drum, hence, the die cost of $2250 amortized at the rate of seven parts per plane reduces to 8c per part. Adding this to the total cost, Col. 16, it can be seen that 44c plus 8c is less than 80c shown for the die casting. Therefore, die costs never materially effect unit costs except for limited contracts. Occasionally, however, when plastic and metal costs are close together, an excessive die cost can make a big difference.

Metal (left, top to bottom) and plastic (right) counterparts of trim tab cable drum, fuel cell support and fuel transfer dial

Plastic forming has recently begun to take place in aircraft plants. Being a newer development, most factories have had little chance to analyze this process or determine its possibilities. However, North American Aviation has set up a plastic forming department and many laminated parts are formed daily to meet production demands. Through work done in the Estimating Department for engineering on price estimates between plastics and the material that plastics replace, it has been found almost in every instance that a saving has been obtained.

A substantial saving can be shown, using plastics, on parts that would otherwise be formed of aluminum or steel on a drop hammer. The saving in this manner is twofold: First, less material is used and; second, less time is required for other operations. On a drop hammer part, a trim of approximately 4" around the entire part is obtained. This material is of scrap value only. This cut must be made on each piece individually. Since parts to be formed on a drop hammer cannot be drilled or punched before forming, these operations are done individually, after forming and being cut, and are difficult to perform because of the shape of the parts after forming. Special jigs are required for these operations, which are usually costly. The plastic equivalent of these parts can be gang routed, drilled, punched while flat and then formed.

There are some parts of aluminum and steel that are firmed, on wooden dies, by hand. These same parts could be formed much faster, and with less help, of plastics with a male and female wooden die. The small amount of cost of the new die could be saved many times over by the savings in fabrication time. END

SUMP JARS *of Plastic*

FLY THE WARTIME SKYWAYS

Battle planes which turn and twist in flight are now protected against damage from dripping acid by an acid-resistant, light-weight, transparent, easily cleaned Plastic Battery Drain Sump Jar. Just one of many of Amphenol's developments in critical plastic products.

AMPHENOL DEVELOPS! Amphenol found a way to make the Jar with a screw top of Polystyrene, injection molded. Amphenol's plastic weld makes it possible to anchor specially shaped tubes into the top. Clear Amphenol vinyl tubing, which Amphenol extrudes, makes the flexible connections to battery and outside of ship.

Amphenol's well-staffed engineering, designing and research departments are, in this way, daily developing new and better parts and products of plastic for many manufacturers.

AMPHENOL PRODUCES! Over 4,000 of the country's critical buyers specify plastic covered high frequency cable *extruded* by Amphenol. Not one but several batteries of *compression molding* machines produce millions of parts made of the thermosetting plastics. Thermoplastic parts from the smallest polystyrene beads up to parts of large size are made on a battery of *injection molding* machines which includes one of the largest injection molding presses in the world. When it comes to capacity to make and to do it properly, Amphenol is a leader in providing plastics day and night for war.

AMPHENOL ANTICIPATES... Vast commercial usages of plastic will follow the new developments which have been brought about by war. New plastics —new methods—new production peaks will serve industry in new applications. An interchange of ideas on future plans for plastic ventures is invited by Amphenol.

Fabricating Industrial Tools From Plastics Materials

By James M. Church
Department of Chemical Engineering, Columbia University

Plastics Tools Have Met Strict Requirements of Aircraft Production, May Also Replace Metals in Other Industries

PLASTIC materials have taken their place in aviation not only in the form of bonded plywood or resin-laminated structures, or in parts such as the nose and turrets and sections of instrument panels, but also in the actual process of aircraft production. One of the chief applications in this field has been tooling.

Here plastics can compete successfully with the more conventional tooling materials such as steel and metal alloys, because they have proven superior in many operations. This is particularly true where quick re-tooling for new designs demands a material which can easily be transformed into the intricate contours of the aircraft tool without the expenditure of a large number of man-hours or a delay in production schedules. Plastic tooling has been the answer to this important problem and has brought about the development of new types of plastics in order to meet the rather stringent requirements of tooling material for the type of work done in aircraft manufacturing plants.

The modern airplane is composed of literally thousands of small, integral parts, preformed to close dimensions and fitted together in a definite pattern to form the whole of the airplane. In many respects the fulesage or wing section of an airplane resembles a huge, patched quilt made up of small squares of metal sheet held together by rivets on a structural metal frame. Each metal part must be precisely constructed individually, usually starting with sheet metal cut to a given pattern, then formed into proper shape by selected dies, punches or forms in various types of hydraulic presses. After trimming to exact dimensions, the part is drilled and then riveted together into panels or sections with other similarly constructed parts by the use of an assembly jig. These panels or sections likewise are assembled together to make the whole fulesage, wings, compartments or auxiliary parts of the plane. The construction of the airplane is quite different from that of the automobile because aluminum is used instead of steel for the most part. With the emphasis upon minimum weight, this requires greater exactitude in the tolerances for maintaining maximum structural strength when forming the metal parts for the airplane. Because of the differences in metal characteristics between steel and aluminum, the latter being much softer and more malleable, the methods of the automotive industry have not been wholly adaptable for the building of airplanes, particularly in the requirements of the material used in the tools for forming the metal parts of the plane.

In such tools as punches, dies, jigs, and fixtures,

A teacher and technical consultant in the field of chemical engineering and organic chemistry for 21 years, James M. Church is a graduate of William Jewell College, with post-graduate studies at Harvard and a Ph.D. from Pennsylvania State. He was a former research chemist in the Organic Chemistry Division of Monsanto Chemical Co. and is now assistant professor of chemical engineering in charge of organic technology at Columbia University.

Fig. 1. Typical male and female plastic drop hammer dies for making ends of disposable fuel tank

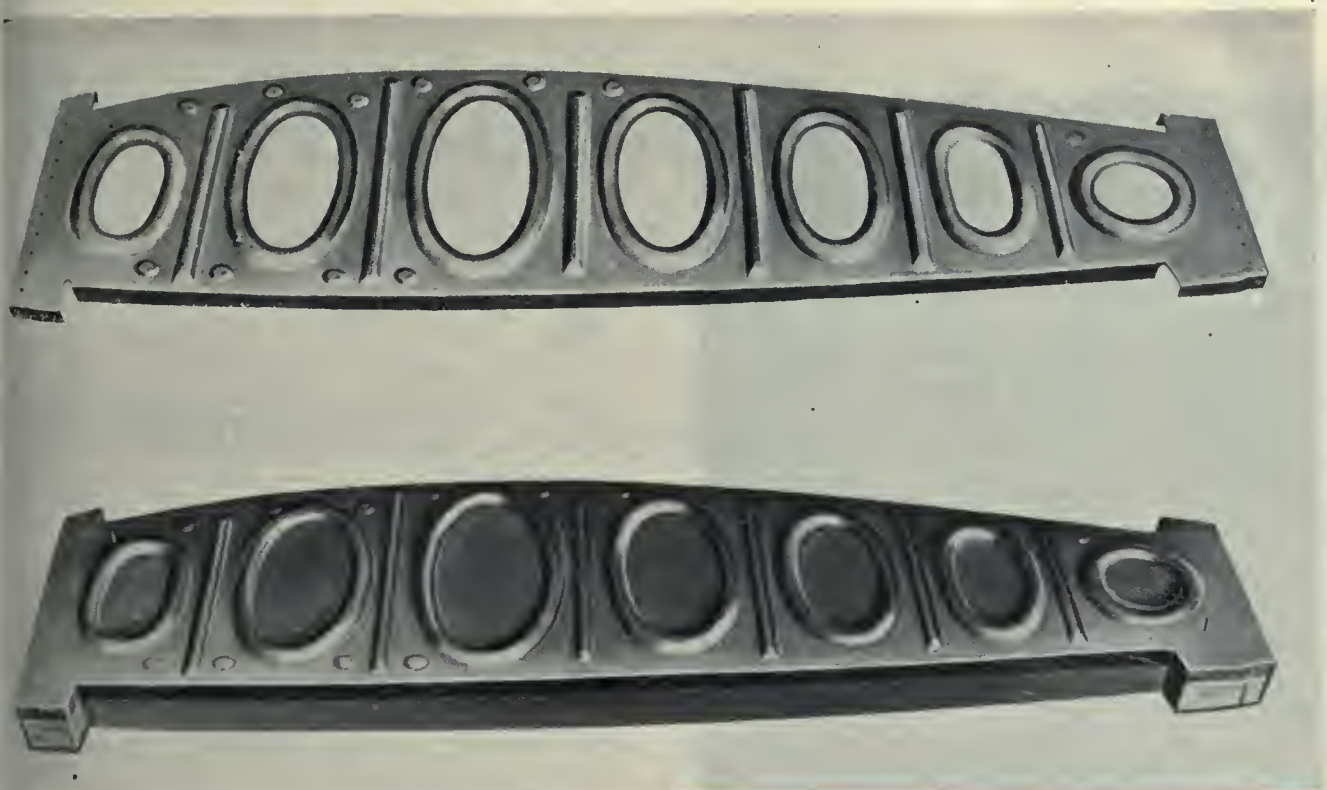


Fig. 2. Bottom, "Thermo-Cast" hydroform weighing 120 lb; Top, Consolidated "Liberator" wing rib web made from it

requirements are apt to be quite severe. An acceptable tooling material would have to meet at least the following four major specifications in order to be anywhere near satisfactory for the various operations in the construction of the metal parts of the airplane:

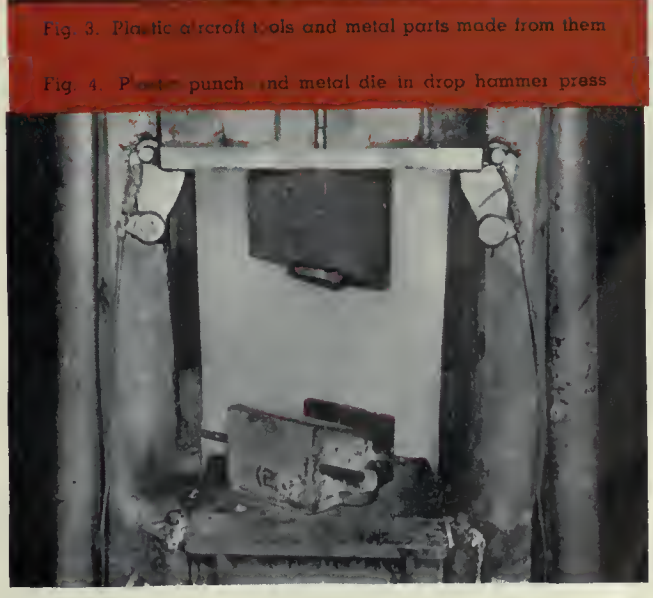
1. *Durability.*—It must be tough, non-fragile and shock-resistant in order to withstand the rough handling and usage encountered in many of the tooling operations. Any characteristics such as brittleness, poor wear resistance, softness or lack of rigidity may result in permanent injury to the tool by fracture, denting or distortion under impact. Imagine the shock and wear encountered by a drop hammer punch striking against the metal sheet supported on a metal anvil type form. Here the material acts in the role of a sledge hammer and yet must not damage the easily malleable sheet metal but rather push it into the shape of the supporting anvil form.

2. *Dimensional Stability.*—Not only must the tool be properly made to conform to rather rigid specifications which allow for only small tolerances in dimensions, but it must retain these dimensions under conditions of usage which include changes in temperature and humidity, as well as contact with oils and greases. Particularly when under stress, such as the thousands of pounds pressure of a hydraulic press, the material must not undergo any permanent distortion or warpage, but must remain the same for accurate mass reproduction of the metal part.

3. *Chemical and Physical Properties.*—These determine for the most part the general characteristics of the material as emphasized above, but serve also as a guide in evaluating the usefulness of the material where chemical or physical instability are important. Chemical inertness, for example, is important where contact with the metal part or with any reinforcements or metal inserts may cause corrosion. It also denotes physical stability since physical changes always occur with chemical change. Aging and wearing characteristics can often times be measured in terms of the chemical and physical properties of the material. This includes not only aging while

Fig. 3. Plastic aircraft tools and metal parts made from them

Fig. 4. Plastic punch and metal die in drop hammer press



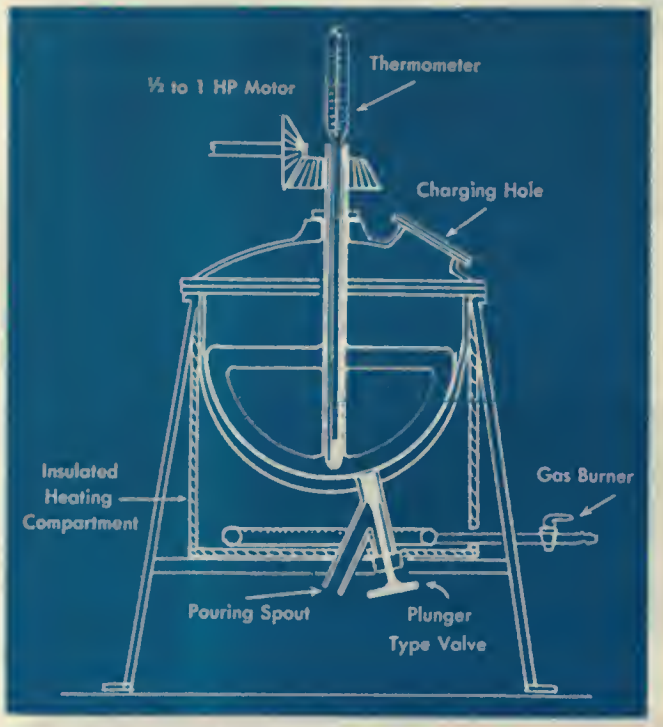


Fig. 5. Small experimental thermo-cast plastic melter

in storage but the more severe conditions of actual use where shock resistance is affected, for instance, by a fatigue of the material, which may cause fracture or disintegration while in use.

4. *Ease of Fabrication.*—This has been the stumbling block for a great many common materials as far as aircraft tooling is concerned, because with changes in design occurring frequently during production runs, new tools must be constructed with a minimum of time and man power. Oftentimes only a minor change in the tool is called for, but unless the material can be easily altered, the tool must be reconstructed, which may require many hours holdup in the production of that part and likewise result in a smaller number of airplanes for that period.

Many other considerations, although less important perhaps as compared to the above, may well determine the selection of the tooling material for any job. One of these is unit weight of the material, since a heavy tool may impede the operation because of its excessive weight. With many women workers involved in the tooling operations of our aircraft plants today, weight is an important factor.

The common materials, such as iron, steel, metal alloys of all kinds, wood and wood products, have been tried but not many meet these essential requirements completely for some of the tooling operations. A large number of man-hours are consumed in transforming the crude block of material into proper contour and size by various machining operations in many cases. Where this may be overcome by employing a casting technique with minimum of finishing afterwards, most of the materials adaptable to this method are lacking in other requirements, particularly durability and physical stability. It was because of these many inherent difficulties of common materials that a new type of tooling material was believed desirable and a search made of some of the newer synthetic products in an effort to find "the ideal tooling material."

Many plastic compositions were studied and submitted to test but only a few measured up to the requirements demanded by the aircraft industry for tooling purposes.

Of all of the plastics tried, only the three following classes were found suitable to any degree, and the selection narrowed itself down to consideration of the advantages and disadvantages of these:

1. *Inorganic Plastics.*—These are not the usual synthetic plastic materials we ordinarily think of nowadays as plastics. They consist of cement-like mixtures which can be cold-mixed and poured in a paste form into ordinary molds later to be set up into compact hard brittle-like solids. Unlike most fluid materials which contract upon cooling to set up into a solid mass, the inorganic plastics tend to expand and, if properly controlled, result in very close mold dimensions of the castings. However, since they are dependent upon a chemical reaction for setting, the expansion seldom stops here and it requires considerable time before they reach a permanent shape. Their brittleness and low impact resistance limit their use in many tooling operations, but their resistance toward heat, where most of the organic plastics will soften or disintegrate, makes them desirable for certain high temperature operations. Another limitation is their lack of chemical inertness which causes corrosion when in contact with metals, sometimes very excessive upon only a short exposure. One of their chief virtues is their relative low cost, but on the other hand, if measured in terms of any re-use, of which they are incapable, the cost may be prohibitive.

2. *Thermosetting Organic Plastics.*—These are the resinous types of plastics which soften somewhat under the application of heat but set up into permanent infusible solids upon further heating. Most of the thermosetting resins require rather elaborate metal molds for their transformation, under the heat and extreme pressures of rather intricate molding machines, into useful articles. The work involved in the fabrication of the mold alone is equal to that of machining a metal tool, and the size restrictions for large molds and huge presses which would be necessary for some of the larger plastic aircraft tools, would make them prohibitive regardless of cost or man-hours involved. However, another type of thermosetting resin has been developed which is capable of being cast in a fluid condition into simple molds without the use of pressure. By a curing treatment at comparatively low temperatures in the presence of a catalyst accelerator, these plastics set up into hard, rigid masses suitable for many tooling operations. Such a plastic is *cast phenol resin*, of which there are a large number and variety with slight differences in properties of the resulting cast plastic. A certain amount of "know how" along with proper mixing and curing equipment, is required for their use. They are limited somewhat by inherent properties such as brit-

(*Continued on page 92*)

Average Physical Characteristics for Thermo-Cast Plastics

Property	Grade Soft	Medium	Hard
Color	Orange red	Medium red	Maroon
Pouring temperature (F)	380°	400°	420°
Softening Point (F) (ASTM Ring and Ball)	280°-300°	300-320°	320-340°
Hardness—Brinnel (100 kg/10mm/15 sec.)	2.0-4.0	4.0-6.0	6.0-8.0
Hardness—Rockwell (m-scale)	—60 to —30	—20 to +10	+20 to +40
Compressive Strength (lb/in²)	6000 8000	8000-10,000	10 000 12,000
Compressibility (1500$/in/in)	0.10 0.20	0.06-0.10	0.02 0.04
Resel Value (%) (recovery 2000$/10 min)	90 95	94-98	99 100
Tensile strength (lb/in²)	800 1200	1200 1600	2200 2600
Elongation (% at T.S.)	25 35	15-20	5 10
Impact strength—Izod (ft-lb/in²)	1.5-2.0	1.0-1.5	0.5 1.0

New STOKES 50-Ton Hydraulic

Completely Automatic Press

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Multiple Feed with micrometer adjustment. Capacity up to 48 cu. in.

High Speed Operation. Opening and closing at the rate of 100 in. per min. with controlled final compression speed adjustable to the flow characteristics of the molding material.

One Man Operates a Score of Presses. Completely Automatic, this press requires only a minimum of molding labor. Once set up, one man can attend a large battery of presses as only attention required is to keep hoppers filled and to remove accumulation of molded pieces.

Low Power Requirement. Only 2 hp. motor required to develop full 50 tons press capacity.

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FJS Est. 1895

War Broadens Uses for Plastic Tape

Versatile Adhesives Find New Applications in Vital Assembly Sealing and Marking Operations

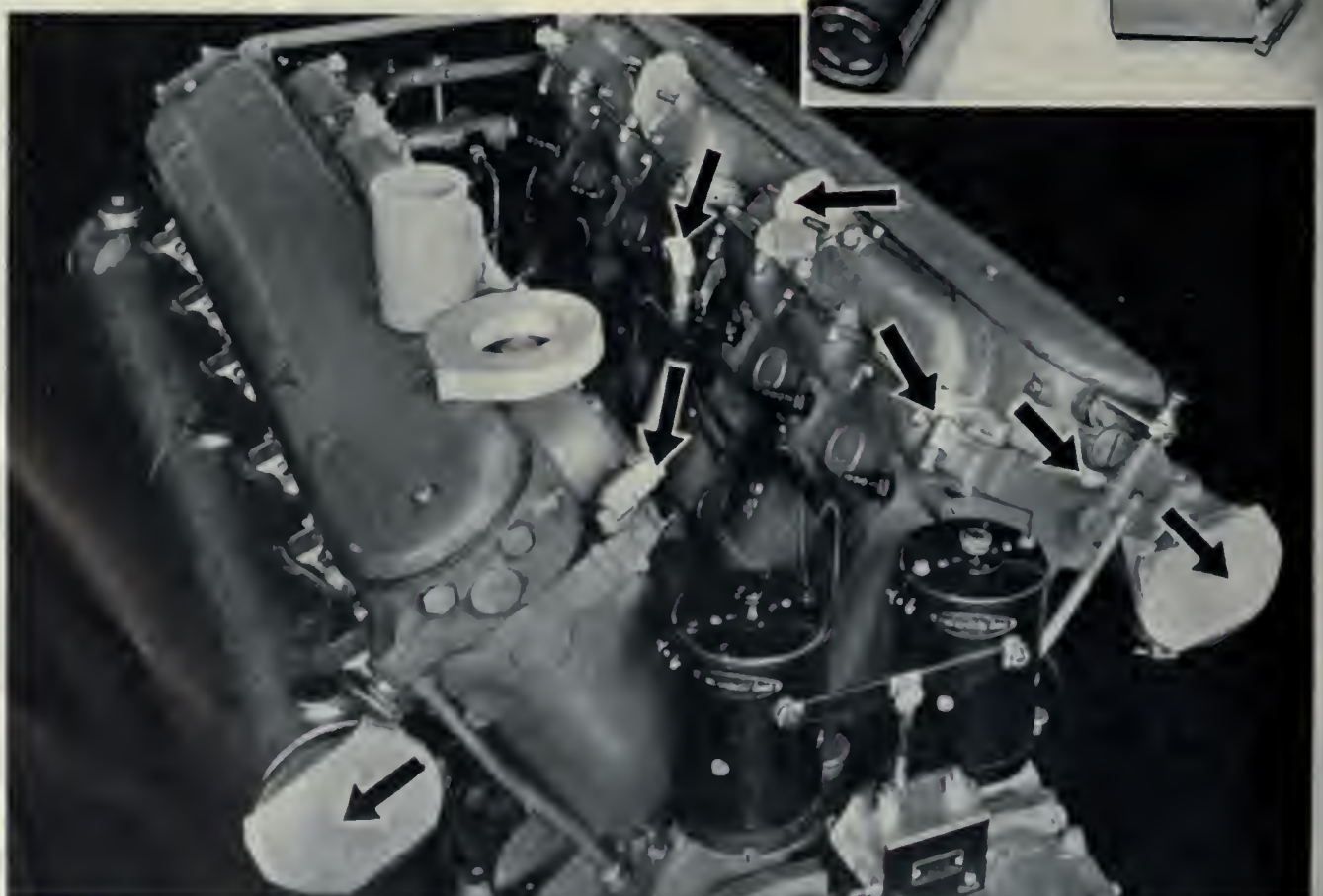
WHEN the Nazis stormed into Poland, American industry was already using *Scotch* tape as a "speeder-upper" in hundreds of assembly and marking operations. In the preceding decade, industrial demands had swelled the *Scotch* tape family from a handful to more than 100 varieties. These multi-colored tapes varied from tissue thinness to cardboard thickness. Some were backed with cellophane, some with acetate, fibre, or combinations of fibre and transparent film. A wide variety of adhesives, with carefully calibrated strengths, increased the number and kinds of jobs these tapes could do.

Most of these tapes had been designed to save seconds or to simplify some complex operation. As time became the essential element in the defense effort, these abilities became priceless.

As an example of the war demand for *Scotch* tape, Curtiss-Wright Corporation includes three rolls of a special tape as a standard spare part in *Warhawks*. These tapes are serving on production and battle lines all over the world.

An outstanding case is that of the cartridge ejection slots in pursuit plane wings. Beneath the wing guns of most American pursuit planes are small slots through which exploded machine gun shells drop. When planes, under combat conditions, had to take off from unfinished fields, the ejection slots often became clogged with sand and dust, causing the gun to jam after a few rounds. Research men in the *Scotch* tape plant got busy, duplicated a wing ejection slot in the laboratory, sealed it with various types of tape and bounced empty machine gun cartridges at it from the proper height. Eventually, a tape was developed which would always break at the impact of the first empty cartridge, and yet be strong enough to protect the slot opening. A similar tape is used to guard airplane wing gun and cannon muzzles from take-off dust, while another type snow-and-mud-proofs the muzzles of ski-troopers' guns.

Broad widths of acetate fibre tape are used to seal openings and vents in engines during storage and shipment. Inset shows how tape holds filter paper around inner canister core for gas mask



Printed tapes have speeded aircraft assembly; in every *Fortress* for instance, some 3000 wires are banded with printed *Scotch* tape. In like manner, bands of as many as three different colors of the tape once used to decorate gift packages now mark plane fuel and vapor lines. Repair jobs in the field are speeded immeasurably by these neat tricks; they become merely a matter of connecting similar-colored lines instead of groping for the proper connection.

The transparent tape, once used to seal sparkling cellophane display packages, now does a less glamorous but more important sealing job between hulls of swift PT boats, holding insulating materials in position between layers of wood. Electric motors, so vital in the war, owe speedy construction and long life to still another tape, which holds units in place during assembly and acts as an insulator on leads and windings during the life of the appliance.

Small strips of colored *Scotch* tape are attached to trays on which disassembled shell fuses and bomb detonators are passed down the line in loading plants. Instant comparison of the color on the fuse parts tray with that of the powder trays shows workmen what mixture to use in loading. At the line's end, reassembly of the fuses, which may have as many as 50 separate parts, is speeded up three-fold by the tape color plan. Similarly, approval or rejection of the shells is indicated in many plants by a colored piece of tape.

When shells are moved up to the front, they are packed in individual cylindrical blank boxes, each size and type identified by a band of colored tape, which also seals the container.

Molding of transparent plastic "blisters" and bomber noses is speeded up by cellulose tape, which holds the flat panes of transparent plastic in position for forming by curved dies. During cementing operations, transparent tape is used as a mask around the areas to be joined. When the job is done, it strips off without leaving any residue or discoloration. It is also used as shock and chipping insulation when the complete sections are bored and bolted into their steel frames.

Thin, strong constructions of *Scotch* tape are used to hold together the corrugated cardboard "forms" around which bullet-proof rubber fuel cells are cast. When the triple layer of synthetic, crude and vulcanized rubber has "set," the forms are softened with steam and water and flushed out piecemeal through the tank openings, with the tenacious tape still clinging to them.

Scotch riveter's tape is a special type developed to speed "cold riveting" in airplane plants. Coated with adhesive only along the edges, riveter's tape holds a row of rivets in place until the riveting gun has done its work, then strips off clearly without leaving any sticky fragments on the rivet heads. Cellulose cloth tape is used to cover rivet and screw heads on plane control surfaces which are finished with cloth. This strong, springy tape cushions the cloth against wear and prevents corrosion of the underlying metal by chemicals in the "doping" compound.

Fire control and De Gausse cables in American fighting ships often contain several layers of moisture-proof *Scotch* tape. These tough, moisture-resistant wrappings keep insulating layers inside the cable from fusing together under extreme heat. Glass gauges and dials in destroyers, corvettes and submarines are shockproofed at the factory with broad widths of the transparent variety of tape to prevent shattering during depth charge attacks.

The new U. S. Army gas cape, a cellophane envelope which protects a soldier from head to heels, has its seams sealed blister-gas-proof with *Scotch* tape. Inside the gas-mask the tape holds filter paper in place around the inner core of the canister.

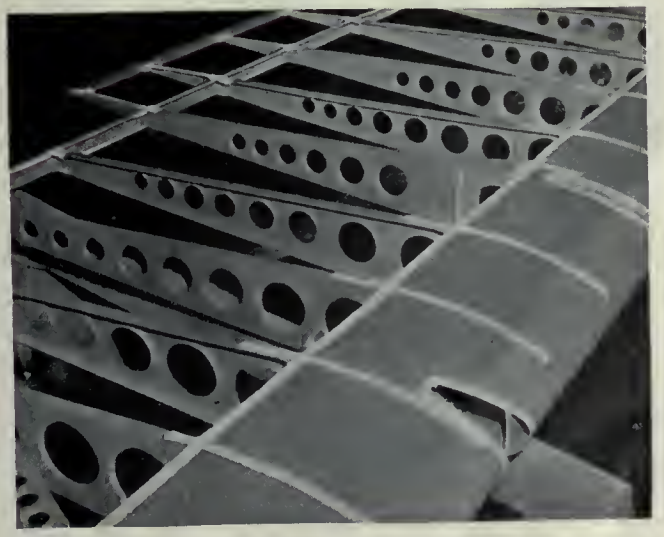
Blood plasma cartons and certain types of field rations are sealed quickly and securely with airtight, waterproof

Strips of acetate tape are applied to airplane nose section to prevent chipping while drilling

and mustard gas-proof type of tapes. Package sealing is one of the most widespread uses for the tape. Protection of tanks, trucks, airplane fuselages and other similar material against corrosion from sea spray and fog, while these war implements are aboard ship en route to the battle fronts, also is afforded by a specially constructed heavy-weight *Scotch* tape. Similarly, guns of powerful four-engined bombers when flying over water are rust-proofed with protective paper securely fastened with tape. At the other end of the scale are tiny, delicate oxygen flask switches, also sealed against dust with the tape. Heavy machinery for the U. S. Engineer's Corps is wrapped in asphalt impregnated kraft paper and sealed with 2" *Scotch* acetate fibre tape.

These are just a few of the jobs that are keeping *Scotch* tapes busy today, on assembly line and battle line. Their exact role in the new era that will begin with V-day is impossible to predict. But it is certain that when war's accelerated production methods are turned to the needs of peace, hundreds of new every day living needs will be filled as a result of wartime experience. END

Covering rivets and screws on airplane wings, tape prevents corrosion from dope, reduces wear



PLASTICS AT WORK IN INTERIOR DESIGN

Attractively-designed stairway, featuring decorative members made of transparent plastic, harmonizing with supporting structural units built of satin-finished aluminum

This attractive light refractor quintet of "Plaskon" lives up to the required IES specifications of intense surface brightness, flexibility of form and total light output

These eye pleasing electric light switch units have enhanced utilitarian value due to the high dielectric strength of the molded "Plaskon" from which they are made

Plastics make an attractive entry into railroading in this synthetic car produced for Union Pacific Wall and furniture feature laminated phenolic and Plexiglas

PLASTICS AT WORK IN CRAFTSMANSHIP

Fly weapan with Tenite head that will not rust or dent and is lighter than any knawn metal; malded by Plastic Engineering, Inc., Cleveland, for American Specialty Co., Amherst, Ohio

Product of R and R Plastics, Inc., this hammer-head is made of tough-resilient "Nitran," a cellulose nitrate derivative widely used an easily-marred metals and precision parts

Cambinatian eyeshield and lens maunt af binacular headband magnifiers are molded of black "Tenite," a light-weight and shatter-proof material produced by Tennessee Eastman Corp.

In addition ta widespread use in housings, packaging and electrical parts, "Plaskan", a urea-formaldehyde resin, finds application in casters, where sturdiness is paramount

PLASTICS AT WORK
IN STORE AND FACTORY

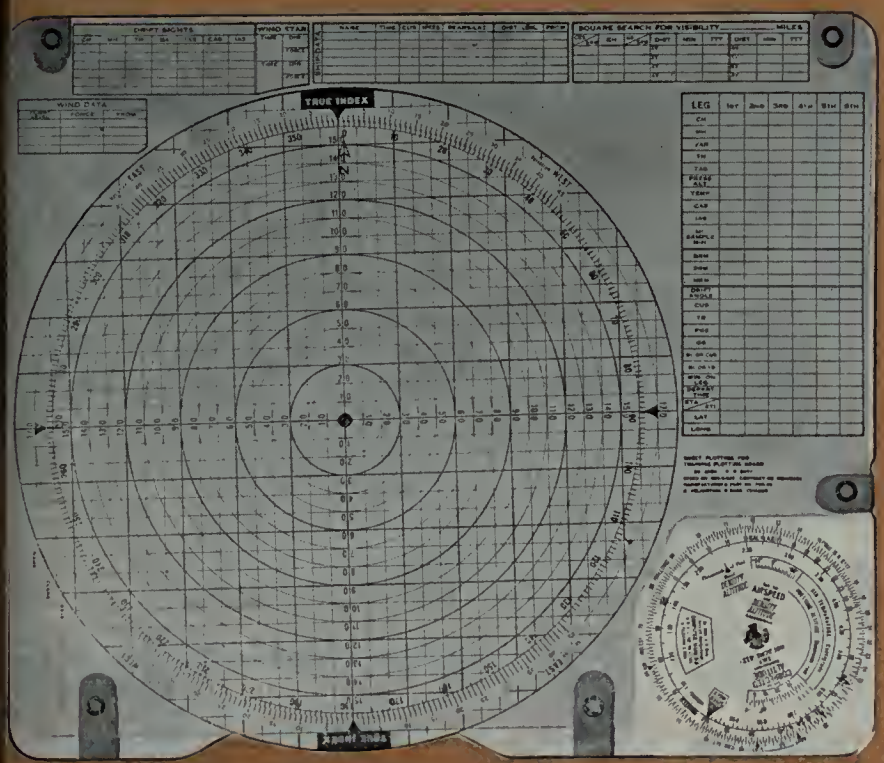
Portability is increased and appearance enhanced by the housing of this modern store scale, which has been molded of "Plaskon," light-weight material, white in color

Transparent plastics, such as those described on page 34 of this issue, can be pigmented or covered with colored material and used in attractive displays, as exemplified by above window decoration

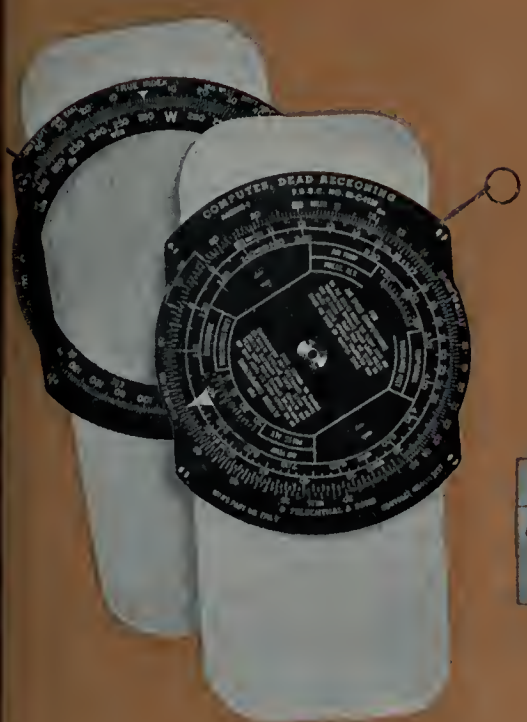
A variety of closures including bottle tops, thermos jug caps and cosmetic jar covers which have been molded of "Plaskon," a product of Plaskon Company, Inc.

Without discoloration or change in appearance, du Pont's methylolurea treatment of wood increases life of fan and permits wood substitute in textile-producing appliances

PLASTICS AT WORK IN INSTRUMENTS



A variety of instruments illustrating outstanding applications for the extremely durable plastic, laminated vinylite. Shown are plotting devices produced by G. Felsenthal & Sons of Chicago: Navigation plotting board, left; a bubble circle sextant, below; dead reckoning computer, below, left, which contains some parts made of molded vinylite; and a drag finder and temperature evaluator, below at the right



Technical Education Produces Trained Personnel

By E. F. Lougee

Chairman, Advisory Board
Plastics Industries Technical Institute

Pioneer Efforts of Plastic School Develop Skilled Men to Serve Needs of the Industry

FOUR years ago there were no plastics schools. Outside the chemical laboratories in a few colleges, it was impossible for a student to learn about plastics unless he went to work as a factory helper. Here he learned how to sweep the floor, run a press, operate a preformer, measure powder, or clean up a mold. College chemical curricula at that time included the theory of polymerization among elemental organics, but that was about all. Today, there are almost as many schools claiming to offer a plastics education as there are plastics materials.

Teaching plastics is no simple matter. The vast range of chemical compounds, each with its peculiar properties and behavior under varying conditions; the multitude of methods employed to form plastics into industrial products; and the broad scope of plastics applications which embrace everything from insulation to lamination, rope to radio, paint to parachutes, and packaging to PT boats; all complicate any attempt to lay out a simple plan for plastics training.

Instructor Emmett M. Watkins closely supervises students installing mold on an automatic molding press

Anyone can learn to operate a plastics molding press with a few minutes instruction. Powder is measured automatically or by hand in prescribed quantities. Preforms are often used. The time cycle and heat control are established in advance by the foreman. The mold is already fastened to the press. All that remains to be learned is which lever to pull and when.

Any boy who can run a lathe can turn a neat piece of jewelry from plastics rod with a little practice. Likewise, anyone can lay strips of canvas, paper or wood, one upon the other, and place them in a press to cure. Almost anyone can spot surface flaws on molded parts. With simple instruments and jig fixtures he can measure tolerances. He can place inserts, file flash, buff corners, and assemble molded parts without going to school or college for special instructions.

But these operations are mere details of plastics production. Planning, designing and engineering come first. Blueprints, specifications, wall thickness, dimensions of the piece to be molded, moldmaking, molding pressures, heat conditions, time cycles, positioning inserts, bosses, struts, knock-out pins, designing jig fixtures, and finally the choice of the *right* plastics material for the job and the *right* size and kind of press to achieve maximum economic production conditions complete the composite picture. These decisions must be based upon experience and knowledge of the many phases of plastics behavior, gained either through long years of hard work or through specialized scientific training in a plastics engineering school.

The technical school is becoming more and more important in the field of education, because it provides opportunity for young men and women, who cannot afford 4 years at college, to enter selected specialized industries on a semi-professional basis. The technical school also provides a means for college graduates to intensify their knowledge in a specific field. The course of study should be practical, intensive and complete. It should be based, and constantly maintained, upon the best current practices within the industry it serves, and it should be clearly detailed for quick comprehension. Prospective students should be carefully screened before admittance, and if they exhibit weakness in any subject which is incidental but not directly concerned with their technical training, they should be advised to brush up on the subject individually outside their technical classes so they will not lag behind.

Plastics Institute Curriculum

At the Plastics Industries Technical Institute, the pioneer technical school in the plastics field in this country, the printed lessons are organized to lead students in an orderly way through the maze of details incidental to

Daniel Szantay

Mr. Szantay and three associates, founded The Sinko Tool & Mfg. Co. 25 years ago. With his guidance, the business has grown and prospered. An expert tool designer, he was also a pioneer in molding thermoplastics. Today as the owner of the company, Mr. Szantay continues to supervise the management of the business.

SINKO TOOL AND MFG CO. ANNOUNCES THAT
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the change *in name* of one of America's leading manufacturers of Injection Molded Plastic parts and products. The Sinko Tool & Manufacturing Company will hereafter be known as SANTAY CORPORATION. For many months, 100% of our facilities have been operating three shifts a day, producing intricate Thermoplastic Parts and Electro-Mechanical Assemblies for the Army and Navy. Invaluable knowledge and experience has been gained, which is bound to be reflected in the products we make in the future. Post-war planners are invited to consult with our master craftsmen on the simplest or most involved metal or thermoplastic part or product.

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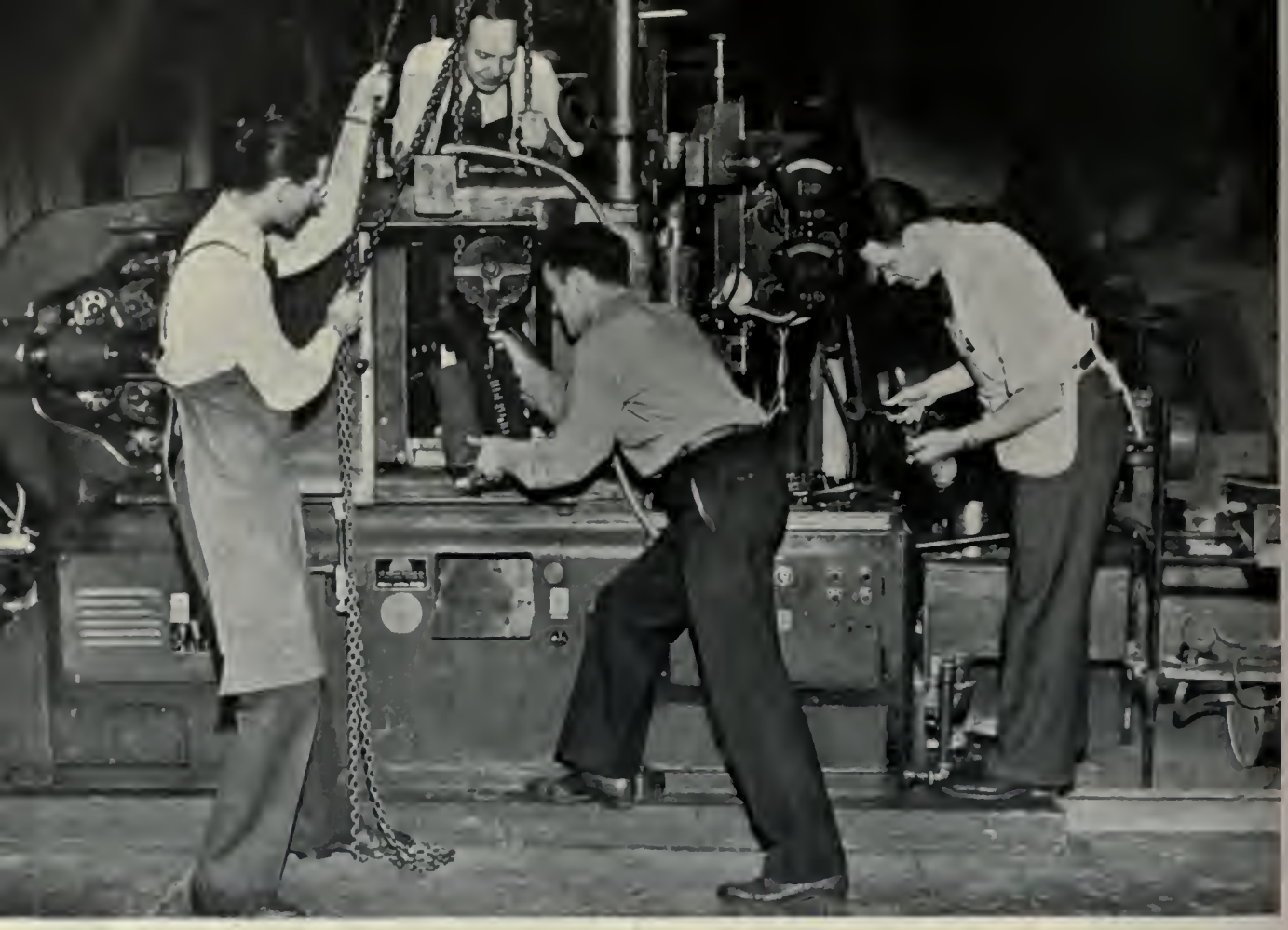
INJECTION MOLDING AND METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES



Installing a mold on injection molding machine is one of numerous training steps

plastics, and to provide them with a ready reference which is invaluable when they enter their chosen field. Courses are technical rather than preparatory. That is, the text contains no extra-curricular material which overlaps or duplicates high school fundamentals. Every lesson is devoted entirely to an important phase of plastics materials, properties, methods or application and none of the student's time is occupied with anything else.

The course is purposely designed to teach how to *use* plastics rather than how to *make* plastics. The highly technical formulations of plastics compounds require an extensive background in organic chemistry which can be taught best in a college or a technical institute providing a 4-year course.

The prime need in education is to learn to differentiate between the various materials and choose them wisely for each application so that failures will not result. The first third of the course is devoted to materials and sources; the second third, roughly, is given over to properties; and the remainder explains methods, equipment, machinery and common practices including designing and making molds. The lecture platform teaching method is employed, supplemented by illustrated slides to emphasize details. Samples are used generously so that students can get the feel as well as the appearance of materials.

A series of quiz sessions has proved exceedingly helpful and interesting. For these periods a "board of experts" chosen from the class are expected to provide answers to problems presented by the remainder of the group. The instructor interprets the questions and acts as referee. A time limit is set in which one of the experts must give the correct reply; otherwise the question is tossed back to the group. Score is kept on the blackboard.

Resident students alternate lectures with shop practice, for which equipment is provided. They are taught the workings of compression and injection presses, on which various objects are molded by the class. Several types of laboratory presses, and one fully automatic compression press, are available. One of these presses will occasionally be completely disassembled, as a part of the training. One group of students dismantles the press and shuffles the parts around the base. Another group takes over and puts it together. Credits are based upon the elapsed time it requires the group to assemble the press and put it into operation.

Right and wrong methods of molding are taught in order to emphasize faults which may occur in actual employment. For example: A group may be turned loose on an injection press which has been purposely adjusted to provide too little heat or too little pressure, with the result that the molded part is incomplete when it comes from the press. Students are asked to suggest remedies and the instructor makes the suggested adjustments and another part is pressed. In this way students learn *why* molded parts are crumbly, incomplete, or burned, and they learn *how* to adjust their press to prevent this.

Materials manufacturers sometimes send new compounds to the school for experimental work before they reach the general market, thus students become acquainted with their working qualities in advance and can appraise their properties. The school has installed one of the most modern high-frequency units for preheating preforms to speed molding operations so that students may become familiar with this type of equipment now being introduced into the plastics field.

Molding, while important, is but one branch of plastics education. Students learn how to apply laminating resins to various fibrous fillers such as paper, canvas, glass fabric

WRITE FOR THIS *New* CATALOG

THE NE line of Rubber & Plastic processing equipment is covered in this 36 page catalog. Many new specialized machines recently developed to meet war production demands are shown. Triple Stage Extruders covered by separate folder—ask for it along with catalog if interested. Request on company letterhead please.

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Part of the training consists of making observations on a flow-testing machine

Students form plywood by rubber bag vacuum technique with the assistance of the instructor

and wood veneer. Every known type of resin is used for impregnating. Then the parts are pressed and compared with standard makes of plastic laminates. Standard ASTM methods are used for testing, and the laboratory is well equipped with ovens, coldbox, impact testing devices, Universal testing machine, and Peakes-Rossi flow tester. Parts are sawed in two and tested for moisture absorption. Cross-sections are examined under magnification to determine their porosity. Insufficient or excessive cure are revealed this way.

New low-pressure methods with all sorts of adhesives come in for a fair share of practical experiments. Expendable gasoline tanks, helmets, aircraft fairings and other projects are worked out. Vacuum pressure, rubber-bag molding, clamping and oven drying, and high-frequency electronic curing are all part of the program to make the course of study as useful as possible.

Fabricating from rods, sheets, and tubes, is another essential branch of training at the institute. Here, student projects begin on the drafting board where design, specification, dimension, and material choice must meet the approval of the instructor before materials are issued. Then comes the practical mechanical conversion of rods to jewelry; sheets to gas masks; or tubes to picture frames. Students are allowed freedom of imagination in fabricating, limited only by the practical aspects of the materials they choose. Drills, saws, lathes, sanders, buffers, arbor presses and ovens are provided to facilitate various operations. Students learn by doing, and the results of their work are clearly visible in the things they make.

Drafting and mold design, so important to plastics conversion of any sort, occupy many hours of a student's time. This includes visualization of parts to be fabricated as well as design and blueprinting of molds, jig and shrink fixtures, positioning of knock-out pins and other engineering details. The plastics engineering student who spends 1 year at the resident school must design and prepare complete drawings for several molds of different types during his term.

The institute offers a complete 1-year engineering course in Los Angeles, where it originated, and has extended its operations into such communities as Chicago and New York, where it conducts 20-week evening forums for the benefit of key men and women from industry, intended to familiarize them with the plastics field. Pre-requisites for the engineering course are simply that the applicant have high school education or its equivalent and be 18 years of age.

Students come from all walks of life, from far and near, and from a wide variety of industrial fields. The government of India sent a state scholar from Calcutta, a chemist with a master's degree, to absorb plastics information which will be used as the foundation for a new industry in India after the war.

The Outlook

As new industries turn to plastics they will need skilled men with knowledge of these peculiar materials so mistakes of the past will be avoided and plastics will be used where they can serve best. The competition of plastics and metals postwar will not be as great as some assume. The "battle of materials" we read about is largely a myth. Plastics have their place in industry alongside most other materials. Frequently they will be used together, each lending its specific properties and characteristics to the other, as they do in plywood, laminated glass fabrics, or in combinations of rayon, nylon and wool. Economics, the quality of the plastic and the availability of experienced personnel determine what place plastics will have in the post-war scheme of things. END

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Cellulosics

Offer Versatility with Strength

Toughness Is Proven by Ability to Take Injection Molding in Thin Cross-Section

(Continued from Page 37)

plastic to its ever-growing list. Cellulose nitrate is still being made in large quantities in the plant first built for its manufacture in 1872. It is used to fabricate sheets, rods, tubes, films and foils (though not as a molding powder.) In 1910 cellulose acetate photographic safety film was introduced and this has widely replaced the earlier inflammable celluloid film of cellulose nitrate. In 1927, based on the World War I discovery of Camille H. Dreyfus, sheets, rods, and tubes were made of cellulose acetate. In 1928, the Celluloid Co., forerunner of the plastics division of the Celanese Corporation of America announced the perfection of the first injection molding machine, as a result of which production of plastics became practical and economical. In 1936 ethyl cellulose was added to the list of cellulosic plastics, but war needs limited its development and confined production to military equipment. However, the splendid qualities of toughness and dimensional stability inherent in ethyl cellulose have made it one of the most attractive subjects for research today in the field of cellulosic plastics.

The year 1938 saw a new addition, cellulose acetate butyrate, to the group of cellulosic molding material. This mixed ester resembles cellulose acetate, is cheaper and easier to make than ethyl cellulose and its development has been correspondingly faster.

The latest development in molding material is represented by Lumarith Ten which is a "cellulose acetate plus" developed in the laboratories of the plastics division of the Celanese Corporation of America. Lumarith Ten molding materials are prepared from a high acetyl cellulose acetate flake, and combine special moisture and hot water resistance with the excellent toughness and the other virtues of the regular cellulose acetate molding materials.

Derivation and Ingredients

The cellulosic group is so called because each one of them is derived from cellulose, the structural material forming the walls and skeletons of the cells of all plant life. The basis of the cellulosic plastics, therefore, is one of nature's most important structural fibres obtained from some

form of vegetation, notably cotton linters. Use of these natural materials does not exhaust the resources of the earth, for they are replaced with every growing season.

There are four cellulosic flakes which form the basis of the thermoplastic cellulosic materials, namely the *esters*—cellulose acetate and cellulose nitrate, the *mixed ester*—cellulose acetate butyrate, and the *ether*—ethyl cellulose. The flakes are fluffy white bulky powders which are useless as such for fabricating. In order to make them flow under heat and pressure, or to convert them into plastics, plasticizers must be added. There are a variety of plasticizers available and compatible with each type of flake. The plasticizer imparts certain properties to the plastic. For example, some plasticizers are sensitive and others inert to moisture, so that the incorporation of the former would not be advisable in a powder to be used for an application requiring moisture resistance. Some plasticizers increase the impact strength of the final material considerably, though not all will give exceptional impact results at low temperatures. This means that the task of molding powder formulation, that is, preparing combinations of flake and plasticizer for molding materials either to improve a given property or to meet some government specification or to arrive at the most desirable plastic for a given application, is a very real and live one, destined to keep chemists of cellulosic plastics on their toes. Since both the flake and the plasticizer are variables, there is a very wide range of possibilities in formulation. Further, the addition of various amounts of any one plasticizer affects the formulation, especially its plastic flow temperature and molding behavior. Additional plasticizer causes the resulting molding powder to flow at a lower temperature, there being a range of even 15 flow

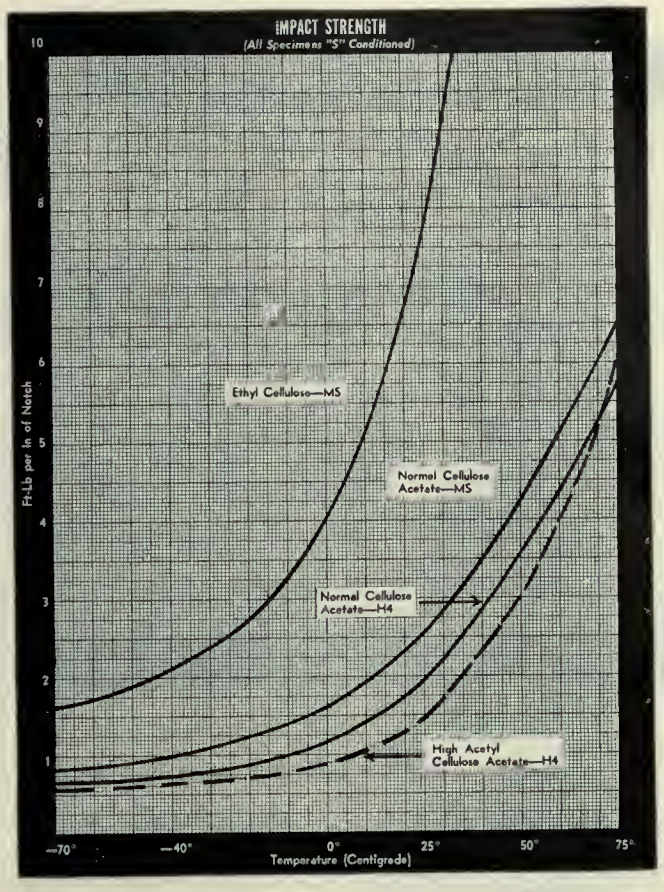


Figure 1

Two uses for "Lumarith," light, tough yet resilient plastic: At left, head band for magnifying lenses with extension permitting lenses to be pushed cut of line of vision when not in use. Punched holes provide eight head size adjustments. At right, plastic is used in industrial safety masks; fits over glasses, offers complete visibility

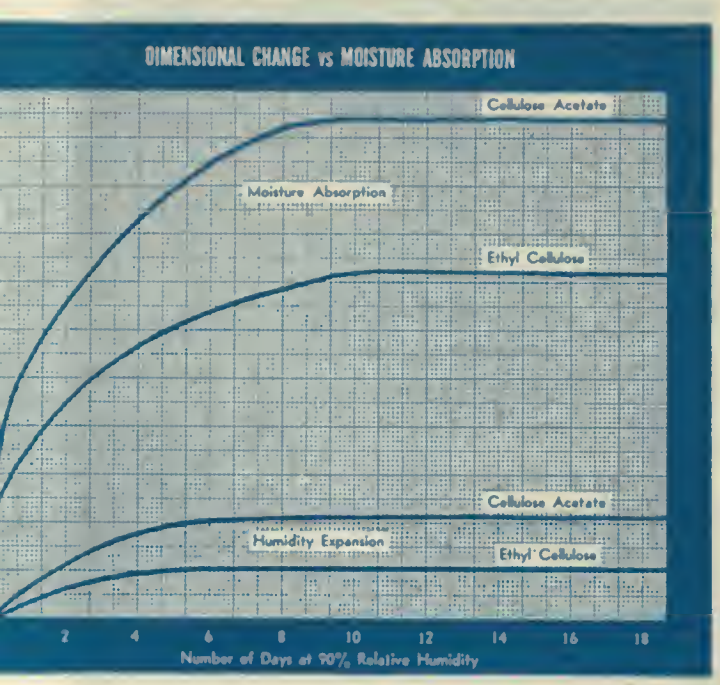


Figure 2

categories in some series using one plasticizer, from very hard to very soft formulations.

Since the formulation of the cellulosic plasties can be largely controlled to meet the requirements of a particular application, it may be said that cellulosic plasties can be custom made to meet the requirements of the custom molder. Other thermoplastic molding materials, such as polystyrene and methyl methacrylate, are resins, and as such their properties are fairly set, allowing of only limited modifications.

The versatility of formulation, a property of the cellulosic thermoplastics, should be seriously considered by those interested in injection or extrusion molding.

Comparative Strength

So far we have placed the cellulosics in the plastic picture from the point of view of their origin and importance. Now let us compare some of their outstanding properties with those of other plasties.

The tests by which the various plasties are compared have been established by the ASTM, and they bid fair to becoming the nucleus of the technical tests to be adopted for the engineering control of plasties, since it is felt that plasties need to be evaluated in much the same way

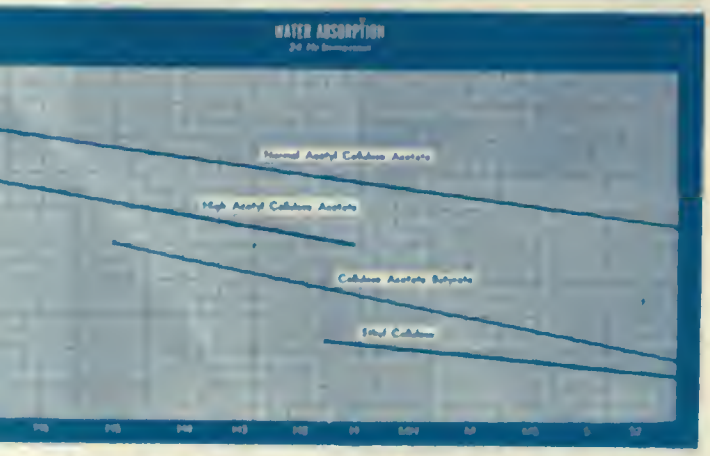


Fig. 3. Percent of water absorbed in 24 hr based on original weight of conditioned specimen. Symbols at bottom show flow temperature range from hardest to softest materials

that other structural materials are, such as metals and glass. Among the most important properties of any structural material is toughness and it has already been stated that the cellulosics are the toughest group of plasties. We are now on the spot to prove it. The word toughness is not an especially well-defined scientific expression, nor can we find a test evolved by the ASTM that will give a simple value for it so that different plasties may be readily compared for toughness. It can be said that there is no adequate measuring rod of it as yet established. However, it may be described as that quality of a material to stand a good deal of knocking around in the course of usage—in other words, its ability to take punishment. The toughness of a plastic therefore, is estimated in terms of the record of its performance *in actual use as a molded part,* but it is not easy to get the data of this record on diversified molded objects, partly because so many variables enter into the molding of different pieces and partly because no standard test of toughness can be readily applied.

The less brittle the material, the more work it takes to make it fail and the more tough it is, and vice versa. In other words, toughness is proportional to the work needed to break the specimens either in tension or in flexure by impact. The energy to break, or working capacity becomes the true measure of the toughness of a plastic material.

Hence, we fall back on to the performance of standard test specimens molded under controlled conditions to obtain results on impact, or resistance to shock and on flex-

Historical Development of Cellulosics

Date Introduced Commercially	Name	Applications
1872	Cellulose nitrate	Sheets, rods, tubes
1890	Cellulose nitrate	Continuous film
1910	Cellulose acetate	Photographic safety film
1927	Cellulose acetate	Sheets, rods, tubes
1927-33	Cellulose acetate	Pioneer development of injection molding machine and molding powders
1930	Cellulose acetate	Foil (transparent wrapping material)
1936	Ethyl cellulose	Molding powder and sheets
1938	Cellulose acetate butyrate	Molding powder
1939	Cellulose acetate propionate	Sheets
1939	Lumerith X (Cellulose acetate)	Molding powder
1940-41	Cellulose esters and ethyl cellulose	Profiles and tubes by extrusion
1942	Cellulose acetate butyrate	Foil

ural and tensile strength (or resistance to load) and interpret these as a measure of toughness of a given plastic.

The resilience of a material to these stresses, its ability to absorb energy and resist permanent deformation, constitute its toughness and may be expressed as working capacity or energy needed to break a specimen in tension, energy to break it in flexure and by impact.

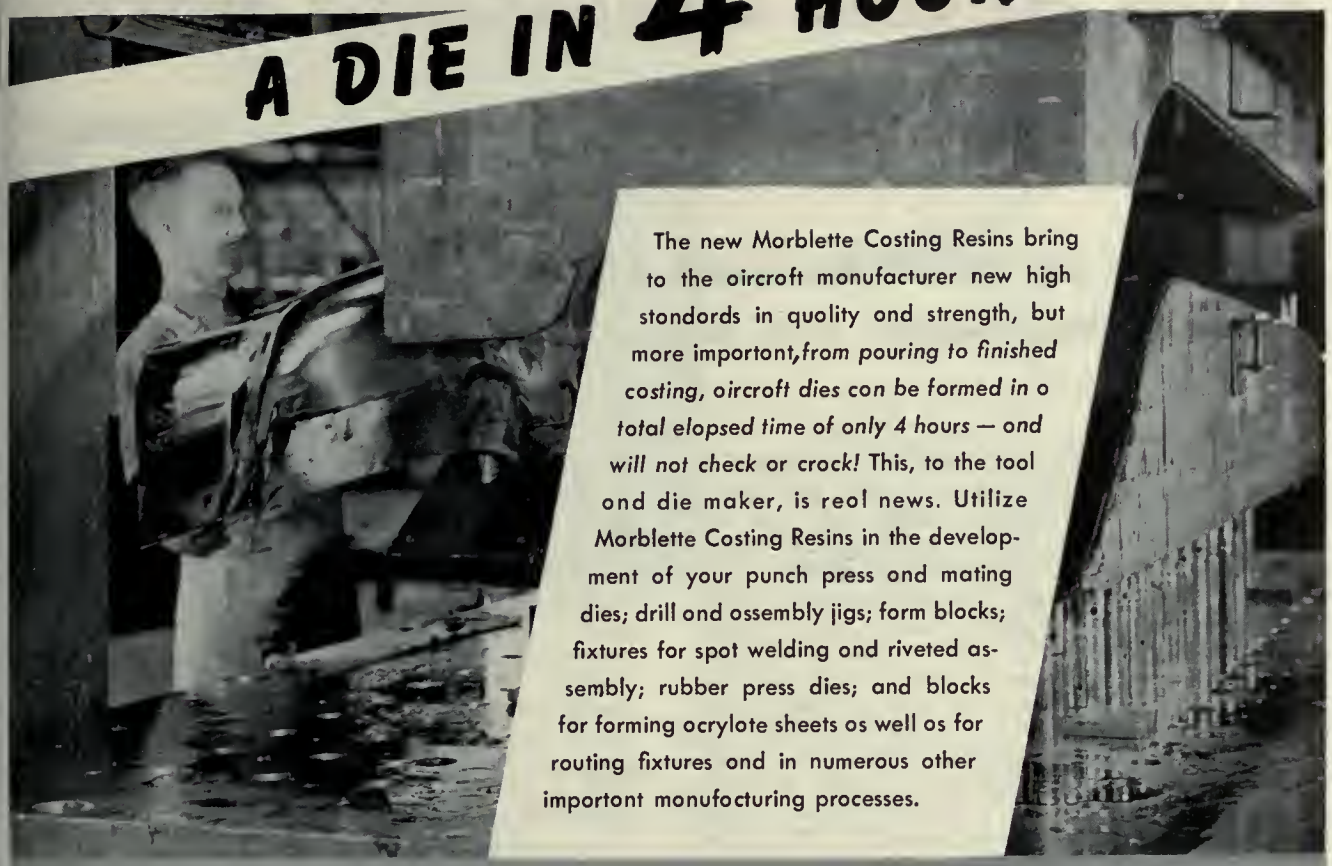
One expression of the toughness of a plastic is called the impact strength, or the energy necessary to break a specimen by a sudden or sharp knock. It is a good measure of the resistance to shock of a material, and as such is another indication of toughness. It has been found especially useful for comparing the toughness of the various cellulosics plasties among themselves, and it would seem that experience of toughness in the field determines the results obtained for impact in the laboratory.

A study of the impact strength of several groups of plasties generally over a temperature range of —70° to 75° F. shows that toughness is a virtue of the cellulosics over the whole temperature range (Fig. 1). Within the group of cellulosic plasties wide ranges of values for impact exist. The excellent impact strength of ethyl cellulose—especially at low temperatures—is noteworthy. Their deep curves of impact strength over a wide temperature range contrasts noticeably with the straight line values

(*Continued on page* 95)

From Pouring To Finished Casting....

A DIE IN 4 HOURS!



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THE MARBLETTE CORP.

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Achieving Translucence With Resins Containing Barite

By Harold J. Luth

Chemical and Mechanical Engineer

Opacity and Gas Pockets Eliminated; Resin Produced Combining Machinability with Increased Hardness

THIS article might well be called "The Strange Case of the Missing Barite"—it has a good deal of the mysterious in it. An ordinary casting resin had been made up, and after the initial condensation and before the water had been removed barite (barium sulfate) was introduced into the solution. The distillation to remove the water went on in the ordinary manner, and the barite was there, plainly swirling around in the flask. Since there was a substantial amount, some 35 to 40% of the resin, the mixture was quite an opaque white. Then, somehow or other, the barite was spirited away; first it was there, and then it was gone. Instead of an opaque mass there was a crystal clear resin. This was cast, was polymerized in an oven, and then, just to be sure, its specific gravity was determined—1.72. The barite was still there, but it had become invisible somewhere along the way. There was a definite object in introducing the barium sulfate into the resin—to increase its specific gravity. But, as is often the case, important properties which were not anticipated were discovered—a transparent resin materialized, with increased hardness and abrasion resistance.

The introduction of barium sulfate has never been accomplished before without the cast article being exceedingly opaque and usually full of gas pockets. The problem is to get the heavy material into the resin without raising the viscosity unduly, and without making the cured product a dead white. The assumption has been that only if the barium sulfate could be ground down to the fineness of the wave length of light would it become invisible. The practical problem of ever grinding the sulfate to such fineness is staggering.

The Process

The casting resin selected was very ordinary—pure phenol and pure formaldehyde 37%, are reacted together, with barium hydroxide as a catalyst, the proportion of formaldehyde to the phenol being two mol weights to one. To get a specific gravity of 1.72, the barium sulfate must run about 37% of the final product, which is quite a mass to dispose of. The desired quantity of barium sulfate is added to the mix, which is distilled under vacuum and at a low temperature to remove the water, the boiling point gradually rising as the water is removed.

All this time we have a hydrophilic resin, and a true solution of resin and water, with barium sulfate suspended in it. Eventually all but about 12 to 15% of the water will be removed, and the temperature will have risen to somewhere around 70° C. The barium sulfate will have disappeared, and the resin will be crystal clear. Some glycerin is added, and the resin further hydrated to the extent necessary to get the degree of opacity desired in the final cast. Those who have followed the literature on cast resins know the theory that hydrophilic resin upon being polymerized becomes hydrophobic. At the time the resin is cast it contains some water in solution; upon polymerization the water is precipitated out in a colloidal state, and as a result acts as a pigment in the resin. Hence, the degree of pigmentation can be controlled by the percentage of water left in the resin at the time of casting. The transparent resins are modified with the addition of organic acids to keep the water and the catalyst in solution.

It is astonishing that when the resin containing the barite is modified to make a transparent resin, a newspaper can readily be read through a ⅛" sheet of the polymerized resin.

Properties of the New Resin

The resulting cast material has desirable properties other than the increased weight. Most important is the increased hardness. When cured at 80° C for 48 to 72 hr. the material will have a hardness of from 100 to 110 measured on the Rockwell hardness tester using the L" scale. The abrasion resistance is increased very greatly, and the flow under frictional heat greatly reduced. Hence ornamental articles after being highly polished do not tend to scour and become foggy on the surface.

As a technical resin, the material holds promise for special applications where these properties are necessary. It takes an exceedingly high hard polish, and plane surfaces can be held very true. In spite of its hardness, it machines very readily with the ordinary tools and cutting devices used in the fabricating trades. Abrasives act freely; there is no loading of the abrasive wheel, or the paper or cloth, whichever may happen to be used. It can be dyed in the same range of brilliant colors that is so characteristic of the cast phenolics. It is fast to light, and although carefully controlled comparisons have not been made, tentative experiments point to a light fastness definitely superior to that of the present cast phenolics.

Odd Behavior in Alcohol

Some interesting observations have been made on the apparently unique resin. A specimen of the unpolymerized resin can be put in alcohol and thinned to such a degree that one would expect the barium sulfate to settle out,

(*Continued on page 94*)

India Comes to America

Even mystic India, with its ancient traditions and ties with the past, recognizes the importance of plastics in the future scheme of things. Typical of the new generation of India now planning for its future is Muhammad Ali Azam, who has come half way 'round the world to study at the Plastics Institute.

Naturally we are proud that men from many foreign countries come to the Plastics Institute to get the finest available technical training in this vital field. But we are just as proud of the many Americans studying with us and preparing to contribute their efforts toward the development of the plastics industry.

If any of your employees or anyone you know is interested in acquiring a basic knowledge of plastics, either by resident training or home study, your inquiry is welcome.

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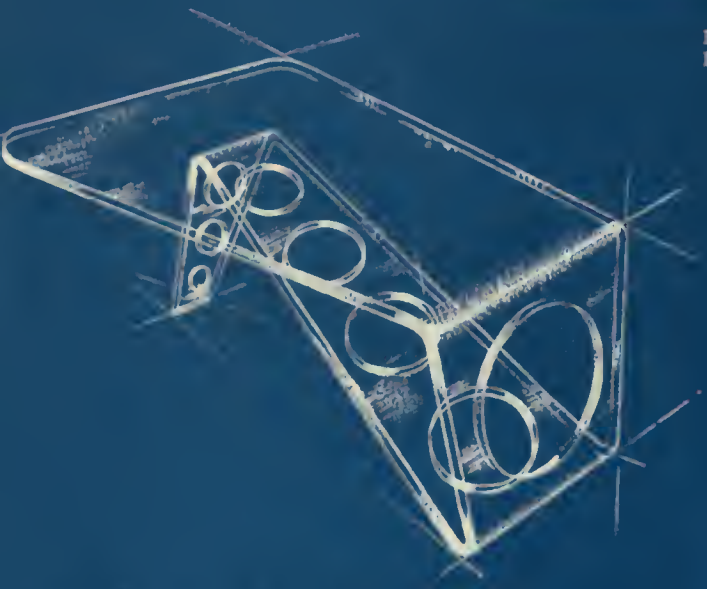
ON THE DRAFTING BOARD

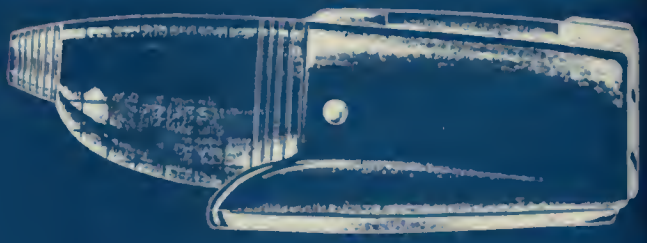
Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

Drawings by Julian Krupa,
Plastics' Art Department

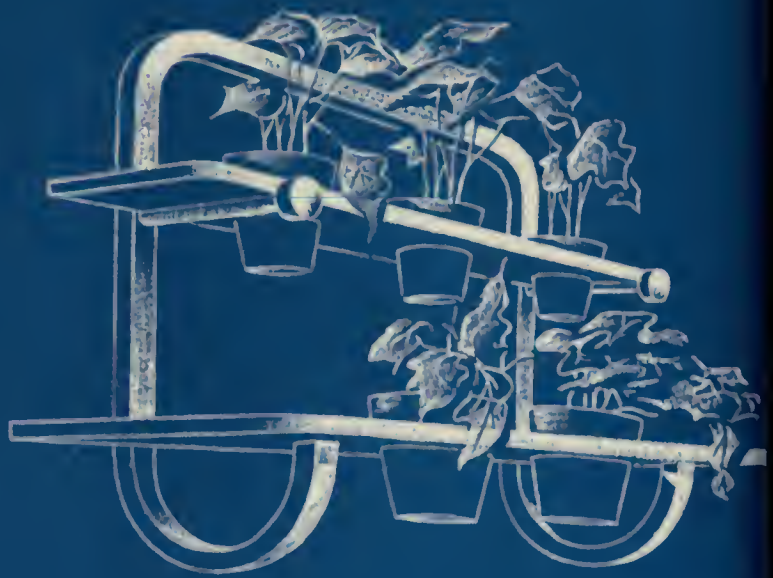


This coffee table of transparent methyl methacrylate or vinylite can be manufactured by a simple bending process. Holes are routed in and edges are buffed to give it style. By Henry P. Glass, Chicago

Above is a streamlined fleshlight. A plastics case, a tapered shape and an adjustable shade which will control the light beam are its advantages. Below a vacuum cleaner, combining motor and filter. Dust bag is removable in one motion. By Dave Chapman, Chicago

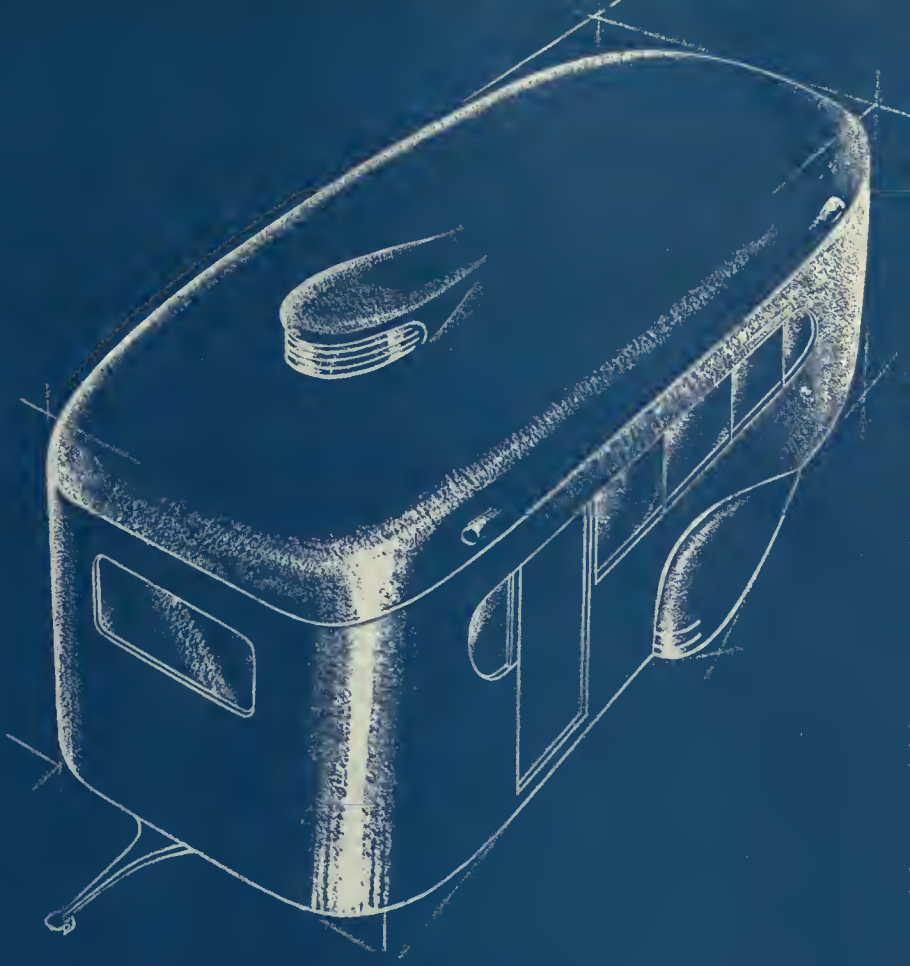


To manufacture this chair, pattern is routed from thermoplastic bonded plywood. Piece is then molded to shape in one operation by heated male and female molds; foam rubber padding is then applied. By Henry P. Glass, Chicago



Where to place flower pots is easily solved by this molded plywood hanging shelf which lends beauty to the wall. The entire curved form is in one piece. Design made at Cooper Union Art School, supervised by Saul Yelkert

This washing machine sells itself. Any customer can see all its working parts. It is unnecessary for a salesman to point out the drain and timer controls or the clear plastics top. These factors save time and energy and add to the beauty of the laundry room. By Dave Chapman



This trailer top is complete with helpful accessories. The top is made of Co-Ro-Lite by low pressure molding. Streamlined ventilator and a running and parking light are formed in one-piece. By Egmont Arens, New York

Boating troubles such as weeds caught in the propeller are eliminated in this jet propulsion outboard motor. An attractive motor cover is heat and salt-water resistant. The design is by C. E. Waltman & Associates, Chicago

Comfort and good view are combined in the above deck house of a cruiser. It is a one-piece affair made by low pressure molding of Co-Ro-Lite. Utility joins beauty for better boating. By Egmont Arens, New York

CAPITAL Report

By Arnold Kruckman

PLASTICS' Washington Correspondent

SINCE there is such a lucid exposition of MPR 523 in a separate article in this issue, written by the OPA official in charge of this order—S. S. Ullman—there is no need for broad comment on that subject here. To give credit where credit is due, though, it should be said that Mr. Ullman succeeded in processing the amendment clarifying the original price order in a short time, whereas it would often require months to put such a change through the complex machinery of OPA.

Some further explanation may be given here of what are *not* considered plastics products within the meaning of MPR 523. A manufacturer of plastic products is defined as a regular manufacturer of another product when he represents himself in the trade as a producer of the other product through catalogs, price lists, and other advertising material; and when he runs the dies or molds used in the production of the other product.

It is clarified specifically that the term "plastics products" for the purposes of the price order does not apply to natural rubber or balata. Nor does the term apply to plastics products assembled with other products, and sold as another commodity.

Reconversion

The plastics industry is reported here to have a minimum reconversion problem. While waiting for the major civilian program to swing into action, it is expected to be able to keep all its facilities engaged in producing insulating materials, novelties, materials for the building trades, and synthetic fibers for textiles. Those who should know apparently anticipate a tremendous expansion in the use of synthetic fibers for fabrics for every conceivable purpose in daily life. An interesting probability, much discussed, is that the cost of clothes will drop astoundingly. Within two or three years after the close of the war it is expected the real rise in production will develop. The first broad use will come in automotive upholstery, handles, knobs, equipment, even in body materials. Military data about plastics is expected to reveal astonishing strength and lower weight. It also is believed in Washington that appliances of all kinds will use plastics in place of present materials. The Government people are giving much thought to comparison of the cost of plastics with that of the lighter metals. Caution note: the talk is that magnesium and aluminum, and new forms of the established metals, are expected to be produced at much lower costs, and will be able to win from plastics in some fields.

Available and Critical

WPB through the Chemical Bureau, released the encouraging word that more vinyl resins, containing less than 92% vinyl chloride, are available, which means that a larger allocation of the material will be permitted for combs. WPB attributes the increased production to more efficient operation of the existing plants.

At the same time WPB let it be known that increased quantities of methyl ethyl ketone were available for civilian uses, although it was warned that the condition is temporary, and is due to a temporary reduction in use by manufacturers of coated fabric products.

Acetone, used in plastics, rayon and penicillin, is momentarily more plentiful, but may become tight again with greater war needs. Butyl acetate was appreciably easier because there was a greater supply of solvents, due largely, to the scarcity of phthalic anhydride. This particularly helped production of civilian nitrocellulose lacquers. Toluene is still critical, and benzene had to be taken from stockpile for military needs, which reveals greater scarcity.

Methyl isobutene ketone and phosphorous, formerly controlled by Orders M-322 and M-230, were transferred to M-300, the central framework for the allocation of chemicals and allied products.

CELLOPHANE

An amendment to Order L-20 permits anyone having surplus stocks of cellophane to sell them without restrictions. However, the purchaser must still confarm to L-20, which means the cellaphane *may not* be used far packaging, wrapping, sealing or manufacturing the fallawing items:

- cosmetics
- soaps
- deodorants
- textiles
  - (other than bandages, sanitary swabs ond typewriter ribbons)
- rubber and rubber products
  - (except as o substitute for Holland cloth)
- hardware, metals and sporting goods
  - (except precision metal parts)
- paper and paper products
- glassware
- candles and wax products
- leather and leather products
- bottles and jars
  - (except those containing wine, other alcaholic liquors ond volatile drugs)
- canned goods
- flowers, plants, seeds and grains
- decarations ond novelties
- bowl basket covers
- household dyes
- household rolls
- soda straws
- sewing supplies
- garment covers
- toys and games
- pipe filters
- coin wrappings
- sponges
- doilies
- hair waving equipment
- brake linings
- molding materials
- window covers
- seals
- milk bottle hoods
  - (except by dairies bottling 84,000 or less bottles per month)
- putty and paint
- plastic products
  - (except tooth brushes)

Cellophane may be used in the manufacture of plastics products. Cellophane may eot be used to enclose drugs except when necessary to protect a drug; candy ond chewing gum; open end sleeves on boots or trays; all food for animals; insecticides; teas, spices, peppers, condiments, sugar, flour, unshelled nuts; dried foods, paste goods, coaked ond uncooked foods, dessert and drink pawders; window cartons and window bags; cigarettes, except where foil is omitted. Cellophane may be used os replacement for metal caps in packaging liquid or paste soaps, industrial oils and greases, bottled foods, putty and paint, if used os a primary closure to a gloss, ceramic or paper tap. Cellophane film may be used as a disc liner for paper tops in the same categories.

Normal butyl alcohol, normal butyl acetate, secondary butyl alcohol, and ethyl acetate are reported more abundant, and WPB Chemicals Bureau announced plans to allocate the materials for civilian uses which have been denied for some months.

Phenolic resins, to a limited extent, have been made available for use in general maintenance supplies. Small order exemptions have been increased for acetic acid, acetic anhydride and acetaldehyde, under Schedule 26 of M-300. The small order exemption per month per person is for acetic acid 2,250 pounds (100% basis); acetic anhydride, 1,920 pounds; acetaldehyde, 1,950. Those using not more than 27,000 pounds must furnish the supplier a certificate; those who use over 27,000 pounds must obtain authority from WPB on Form WPB-2945.

The most recent word from WPB is that alkyd resins are the most critical materials in the entire field of plastics. The current supply is inadequate for essential military require-

ments. There are none available for civilian uses. Maleic resins increasingly are being used as replacements for military requirements. Allocations for civilian uses are unlikely. Methyl ethyl ketone also is wholly inadequate for military needs. It is expected it will be a long time before any is available for civilian uses.

Manpower

It is important if you employ eight or more men to be sure that you are fully acquainted with the latest directive issued by Chairman Paul V. McNutt of the War Manpower Commission, addressed to all regional directors. It instructs them to direct "all male workers to jobs which will permit a better allocation of available male labor. This amendment to Regulation 7, effective May 22nd, will make it possible for a regional director to control placement of men (in all areas) in nonessential or even in essential activity. This program is in keeping with the established principle that all persons have an obligation to engage in work most directly affecting the war program. Another amendment to Regulation 7 limits the number of workers or specified types of workers that may be employed in an establishment during specified periods."

One section of congressional opinion is indicated by Rep. William J. Miller, Connecticut, who, discussing the directive on the floor of the House, stated that the regulations "are simply invoking the purposes of a National Service Act without waiting for Congress to pass such an act."

Areas, such as the Pacific coast, have been losing workers who have moved East to be on the spot when peace-time employment is likely. Apparently it is hoped the new system of manpower control will impell many workers to migrate to areas where workers are needed most.

Incidentally, all those now returning from the armed services, male or female, honorably discharged, or placed on inactive status, are entitled to re-employment in their old jobs, with accumulated seniority, if they apply within 40 days after they are cleared by the armed services. These workers may not be discharged within one year without adequate cause. Conscientious objectors have no rights for re-employment.

Plant Disposition

The Congress also has manifested interest in plastics. S 1963, introduced May 31 by Senator Guy M. Gillette of Iowa, would prevent any Government agency from disposing of any plant or facility which produces styrene, butadiene, butylenes, neoprene, butyl rubber, Buna N rubber, Buna S, GRS rubber, or the ingredients produced therefore, or the products made from any of the ingredients, when the Government has any investment in any part of the plant or the facility. The legislation, which is expected to be enacted, is intended to stop any hasty disposal until Congress finally determines a national policy governing sale, leases or operation of such resources. The proposed Act frankly announces it is intended to prevent monopolistic control over new industries. The purpose is particularly intended to preserve for competitive operation those plants and facilities which use farm and forest materials in making plastics and allied products. In the event a Government agency finds an opportunity to place a property under the control of an appropriate private agency it is provided that the agency must seek approval by submitting a request in writing to the President of the Senate and the Speaker of the House; they in turn must secure approval of the Congress. To obtain the consent of the Congress it would be necessary to give details about the property, including its cost and the extent to which it has been used; the name and history and an appraisal of the responsibility of the person to whom it is to be sold or leased; how much the Government will receive; and a clear statement from the prospective purchaser or lessee about the use he will make of the property. The Government agency also would be compelled to list the names and addresses of all bidders or persons who have been interested in the property. The deal finally would then be concluded by joint legislative action of the Senate and House. The action would not require the approval of the President.

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This proposed legislation is expected to be the model for similar action in regard to other Government properties. Congress fears that in its absence the Government agencies may make deals which it might not approve. At the same time, under present conditions, it has been difficult to arrive at a specific national policy. It is hoped the proposed Act covering plants and facilities for the production of plastics will check hasty action in the disposal of many other war properties, owned or controlled by the Government, which rapidly may be withdrawn from Government production. Washington is watching this bill with unusual interest.

Postwar Export Market

B. F. Cooling of the Chemical Unit of the Bureau of Foreign and Domestic Commerce is convinced that we will have an enormous market for plastic products in Europe, Asia, Africa, and Latin America after the war. He has assembled considerable valuable data about the production potentialities of almost all commercial centers of the world. The Pacific Coast, which regards Asia as its plastics markets, reports its plastics industry has increased far in excess of 500% the past two years. The mysterious Dupont plant in the Pacific Northwest is regarded as the source of future raw materials. Apparently the chief products now considered as the main outlet for Pacific Coast activities will be plywood structures, plywood planes, plastic plumbing, furniture, and packaging for fruit and other foods. It is expected there will be a number of additions to the 12 concerns currently regarded as the principle plastics manufacturers on the Coast. The Coast at present is producing chlorine, caustic ammonia, synthetic benzene, and it has hopes of substantial production of vinyls, styrene, ethyl cellulose, and acrylics. The immediate focus for development is deemed to be the San Francisco Bay region. The Pacific Northwest comes next. The Los Angeles region is rich in possibilities, but its business community apparently lacks live interest.

Plastics Powders

Physicists Irving Hartmann and John Nagy, of the Bureau of Mines, Pittsburgh station, have just finished a series of studies, and explosibility tests, of the numerous powders used in making plastics. The work was aimed at improving safety in post-war industrial activities. The Government is convinced there will be an enormous industrial activity in plastics, after the war. The tests applied to materials ranging from those used in costume jewelry to shatterproof "noses" for bombers.

The study was conducted on behalf of the Dust Explosion Hazards Committee of the National Fire Protection Association. The Association will use the findings in its preparation of a safety code for the plastics industry. The examination included 31 synthetic and natural resins, 15 molding powders, four ingredients of synthetic resins, and seven fillers of molding compounds—57 in all. Fifty-four could be ignited and could propagate flame when brought in contact with a heated surface of sufficient temperature. Fifty were ignited by weak electric sparks. Explosibility increased greatly as the size of the particle was reduced. Many fine powders were found to be only slightly less explosive than the most hazardous metal powders such as magnesium and aluminum. The investigators repot that the potential dust explosion hazard in the manufacture of many plastic powders is greater than that of the common carbonaceous dusts, such as coal or corn starch.

While stressing the constant menace of dust explosions and fires, the report emphasizes that while major plastic-dust explosions have been few, minor explosions have been many with the increase in the volume of production. During the past two years several manufacturers of plastic compounds have voluntarily submitted numerous powder samples to the Bureau of Mines for explosibility tests.

Those who desire a copy of the report may obtain it by writing for Report of Investigation 3751, Inflammability and Explosibility of Powders Used in the Plastics Industry, by Irving Hartmann and John Nagy, addressing the Bureau of Mines, department of the Interior, Washington, D. C. END

TODAY . . .

IT'S DECIDEDLY WORTH WHILE TO RE-CHECK DIELECTRIC SPECIFICATIONS AGAINST THE UNUSUAL COMBINATION OF PROPERTIES OF

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WRITE TODAY *for data sheet giving physical properties of Acadia Polystyrene, with table of specifications on electrical properties.*

★ The combination of highly desirable electrical properties found in Acadia Polystyrene recommend this material for a wide variety of applications. It possesses an excellent dielectric constant value. Its dielectric strength and power factor compare favorably with the electrical quality of ceramics and mica and are superior to any other commercial plastic. Moisture absorption is zero. These and other wanted properties—plus Acadia's wide experience with plastics—suggest an immediate investigation of Acadia Polystyrene. Some values are given below. Complete data are available on request.

Dielectric Constant	2.5 to 2.6
Power Factor, 60 cycles	.0001 to .0003
10^3 cycles	.0001 to .0003
10^6 cycles	.0001 to .0008
Dielectric Strength, Volts/Mil 1/8" thickness	Short time 500 to 700
	Step by Step 450 to 600
Volume Resistivity, ohms-cms	10^{17} to 10^{19}
Heat Resistance	105°F Continuous
Softening Point	190°F to 250°F
Specific Gravity	1.05

Another Acadia Plastic — Styraloy*

combines the low temperature flexibility of rubber and electrical properties approaching those of Polystyrene, and is ideal for numerous electrical applications. Full information on forms available to date and physical and electrical properties may be had on request.

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Plastics Price Control

New Regulation Simplifies Pricing Situation For Industry; All Products Subject to One Order

S. S. Ullman, OPA plastics specialist, analyzes the new Maximum Price Regulation No. 523 affecting the entire plastics industry; discusses part-plastics situation, basis and determination of pricing methods, necessity of filing price increases, relief procedure and required records.

SINCE the 27th of March, 1944, the maximum prices of plastics products, when sold by their manufacturers, have been established by Maximum Price Regulation No. 523. This regulation simplifies the pricing situation for the plastics industry by superseding all those regulations which previously covered a particular plastics item or plastics part depending upon its end use. Now all such products, even those used solely for military purposes, are subject to this one regulation.

There are a number of items excluded even though they fit the definition of a plastics product, but these exclusions have been made because such items are not customarily produced by molders or fabricators. This does not mean that such products are exempt from price control. They are all subject to other regulations.

The original wording of this regulation was rather broad in its coverage. The phrase, "any product made in whole or in part of plastics materials," created an interesting question. Did the Office of Price Administration intend this regulation to include the manufacturer of electric motors or microscopes or other specific commodities merely because they molded or fabricated some plastics part or parts as an incident in the complete assembly of their product? Obviously, the answer is "no."

Part-Plastics Items

The question has been resolved by a recently issued amendment which specifically exempts from the coverage of the regulation plastics products which are assembled with other materials and sold as another commodity by a regular manufacturer of such other commodity. The test is whether such manufacturer through the issuance of price lists, catalogs or other advertising matter, represents himself in the trade as being the manufacturer of such other commodity, specifically naming the commodity.

As an example, the recognized producer of electric motors is not subject to Maximum Price Regulation 523 just because he molds a plastics part which he includes in the assembly of the motor. This is true, too, of metal optical frames which have a little plastics nose-piece as a part of the complete frame. However, plastics combs, though produced by a recognized manufacturer thereof, are nevertheless subject to this regulation because a plastics comb is made solely of plastics materials and is not assembled with other materials.

Price Base Date

The maximum prices of plastics products are established by using March 31, 1942, as a base date for pricing purposes. Thus, for a plastics item in which he dealt on the base date, the manufacturer's current maximum price is the price at which he would have sold the item on that date to a purchaser of the same class. Where the manufacturer had a published price list in effect on March 31, 1942, his current price is determined by requiring the deduction of March 31, 1942, discounts and allowances from the list price in effect on that date.

As an example, the XYZ Plastics Company published a price list as of March 1, 1942. Included in that list were Style #100, Combs, which had a list price of $10.00 per gross. From this list price it was customary to allow a discount of 40% to jobbers, and 25% to department stores. Currently, the XYZ Plastics Company may sell this item for no more than $10.00 per gross, less 40% to its jobbing trade and 25% to department stores.

Where the manufacturer did not have a published list price in effect on March 31, 1942, the maximum price is the last price at which he sold or offered to sell the item during the period January 1 to March 31, 1942, inclusive, adjusted to reflect his base date differentials between classes of purchasers. An order accepted between January 1 and March 31, 1942, constitutes a sale during that period even though delivery was made after March 31, 1942. An order accepted December 1, 1941, and delivered February 28, 1942, does not constitute a sale during the base period. A firm quotation given on February 10, 1942, is nevertheless an offer during the base period, even though accepted in April, 1942; and it would likewise constitute a base period offer even though no sale was consummated.

"Price Determining Method"

All other plastics products, whether sold or offered for sale prior to January 1, 1942 or, for the first time, after March 31, 1942, must be priced by the use of the price determining method which the manufacturer had in effect in his plant for plastics products on March 31, 1942. The term "price determining method" means nothing more than the cost estimating method used by the average manufacturer to arrive at his costs and thereby have a basis for determining his selling prices.

"Formula Pricing"

The regulation provides that in such method the costs of raw materials be included at current costs or at March 31, 1942, costs, whichever are lower. The cost of labor must be determined by the use of labor rates which are no higher than March 31, 1942, rates for similar classifications of labor or similar skills. The other factors, such as factory overhead, general and administrative expenses, selling expenses and profit margin,—all these must be currently included at rates no higher than were in effect in his plant on the base date, March 31, 1942. This is known as "formula pricing," and a report of the formula must be filed with the Office of Price Administration, Washington, D. C.

It is an established fact that the bulk of the molders' and fabricators' production is of a "special" nature. They are constantly called upon to produce new items requiring a good deal of experimentation. Moreover, variations in raw materials, shapes and specifications do not permit them to forecast their production results easily. For this reason, having completed one production run, the manufacturer is required to recompute his maximum price in the light of this acquired production experience.

Filing Change of Price

In the recomputation he must use his base date pricing formula. Should the recomputation result in a higher price, and should the manufacturer choose to charge this higher price, he must file a report of this increase with Washington. Should the recomputation result in a lower price, this lower price becomes the new maximum price, but no report need be filed. No report is required should the price remain unchanged. Having recomputed on the basis of an actual production run the maximum price for that particular item is considered established and is not subject to further recomputation.

Every manufacturer of plastics products who had no price determining method in use on March 31, 1942, or who was not engaged in the manufacture of such products on that date must establish a price determining method at once and submit a report of such method to the Office of Price Administra-

By S. S. Ullman

Parts and Sub-Assembly Section, Machinery Branch
Office of Price Administration

tion, Washington, D. C., for approval. The proposed method must be reasonable in the light of the operations being or to be performed. All rates proposed in the reported formula must be in line with March 31, 1942, rates for the locality in which the manufacturing is to be performed.

Re Prices of Dies, Molds and Special Tools

Dies molds and special tools are so closely related to the manufacture of plastics products, that this regulation sets maximum prices for them when they are sold in connection with the sale of a plastics product. Molders and fabricators are not in the business of selling these items but do so as an accommodation to the purchaser of the plastics product. Investigation proved that it had been industry practice to sell these dies, molds and tools at cost. The regulation follows this practice of the industry, by establishing as the maximum price the cost of the die, mold or special tool to the plastics manufacturer.

Where the latter purchases such die, mold or tool, his resale price may not exceed his own purchase price. Where the plastics manufacturer produces the die, mold or tool, the maximum price therefor may not exceed the current total unit costs of the plastics manufacturer. The term "total unit costs" means the direct unit cost of labor, materials and subcontracted services, plus a proportion of factory overhead, administrative and other expenses, properly allocable to the production of the die, mold or special tool.

Relief Procedure

Although the maximum prices of items sold or offered for sale during the base period have been "frozen," relief may be obtained should increased production costs create a condition of hardship. The regulation provides for the filing of an application for adjustment in the case of an "essential producer" of an "essential plastics product."

The Office of Price Administration may make the adjustment whenever it finds that the maximum price of a plastics product is at such a level that, taking into account the cost thereof, the profits position of the manufacturer and the nature of his business, production or supply of the plastics product is impeded or threatened.

In the case of a manufacturer whose annual sales exceed $200,000, such application must be filed in Washington, D. C. Where the annual sales are less than $200,000, the application must be filed with the regional office or the Office of Price Administration of the same region in which the manufacturer's business is located.

Records Required

Every manufacturer subject to this regulation is required to keep complete and accurate records for inspection by the Office of Price Administration for so long as the Emergency Price Control Act of 1942, as amended, shall remain in effect. The requirements include records of every sale, complete records of published price lists and discount sheets, prices charged during the period January 1 to March 31, 1942, labor rates in effect on March 31, 1942, factory overhead rates, detailed cost estimate sheets, etc. The requirements are really those of any well-run business organization.

In conclusion, it should be stated that OPA officials did not arbitrarily decide that the plastics industry required regulation and that MPR 523 would do the trick. Meetings were held with the Plastics Industry Advisory Committee and with representative molders and fabricators. A tentative draft of the regulation was submitted and the manufacturers were invited to send in their comments. Their advice and suggestions are reflected in a number of the provisions of the regulation. The industry's cooperation with the OPA in the administration of this regulation will be a decided contribution in the effort to stabilize the Nation's economy. END

Here's your connection

FOR A COMPLETE PLASTICS MOLDING SERVICE

FOR, at Columbus Plastic Products you get the benefit of complete facilities and expert techniques in engineering, die making, molding, finishing and assembling of all types of injection molded plastic products. Our years of experience and practical "know-how" are at your service. Learn to rely on us as your connection for better molded plastic products.

Columbus

PLASTIC PRODUCTS, Inc.

505 Dublin Avenue, Columbus 15, Ohio

New York Office — 475 Fifth Avenue

plastics overseas

BRITISH PLASTICS AND RECONSTRUCTION

IT is perhaps insufficiently realized that the British plastics industry is still small. The growth of various manufacturing plants during recent years, stimulated by the impulses of war, has been remarkable, but the overall production is still very limited, and it is not necessarily throughout all its range to the uses of peace. This latter point is important. Just as German ersatz industry arose from compulsions that made it consistent with a political trend, and finally with a war trend, but which made it largely irrelevant in the context of the post-war world, so the British plastics, industry faces a profound reorientation the first importance in assessing the value of the industry both in Britain and to the development of British export trade.

Some important British industrial concerns have developed plastics intensively. Imperial Chemical Industries, Distillers and British Celanese have substantial plants. But both here, and in the case of the companies that are operating subsidiaries, like Monsanto Chemicals and E. K. Cole, the proportion of plastics intensively. Imperial Chemical Industries, Distillers mum capital invested in any one plastics undertaking rarely exceeds a million pounds, and there are comparatively few undertakings. Among the companies whose sole concern is plastics are British Industrial Plastics and British Xylonite, both of whom have a capital around the million mark, Crystalate, with a capital around three quarters of a million, Catalin and Erinoid, with capitals of roughly half a million, and Lacrinoid, a still smaller company.

It has been a hope of many industrial observers that plastics would provide Britain with one of her most active stakes in the overseas markets after the war, and the disquiet evidenced in certain American circles at the supposed scope of British plastics exports during the war will be remembered. In fact, of course, there has been no free export of British plastics at all during the war; it has been tough enough going for the industry to fill purely war requirements. And after the war it is highly doubtful whether plastics can make any serious contribution except over the long term to British overseas income. Not only is there the big operative impediment, that the industry is small and will require large inflows of capital and active laboratory development, and that it must reshape its research to accommodate the revived competition of the older materials, but there is the competitive impediment. The plastics industry in the United States is more fully developed both quantitatively and qualitatively than in Britain, and it is certainly more advanced technically in Germany and, through the German dispersal of industry, in other parts of Europe.

British Role Limited

The part which the British industry will be able to play in European reconstruction is therefore sure to be limited. So far as the phase of literal reconstruction is concerned, indeed, it is unlikely that the British industry will be able to make much more than a token contribution, just as it is unlikely that in this period she will be able to do much more than introduce samples to overseas markets. As to her contribution afterwards, in the years of European development (a very different thing from reconstruction), it is difficult to speak with confidence. Certainly, there will be no impediment from the capital point of view to the erection of a substantial industry capable of supplying domestic wants and many oversea requirements. The British investor has become very plastics-minded, and though this may be the result of a glamorizing of the products and the prospects, it stil remains a certainty that when the capital market is once again free no responsible concern embarking on, or extending its interest in, plastics need fear capital starvation. But this process would take place in conditions which carried a double threat to the young British industry. The first threat would be from more highly-developed competitors,—and here we cannot indefinitely rule out the Continent of Europe—and the second from older products, notably the steel, timber and building industries, which may adopt a multitude of devices to make their appeal equal to that of plastics in service and greater than plastics in terms of economy.

A dominant consideration is the extent to which the raw materials of plastics manufacture are readily and cheaply available. In coal, Britain is rich; in oil she is poverty-stricken. Moreover, many of the coal-based plastics, the ethylene group, can only be derived from coal through the medium of acetylene by the use of electricity on a large scale, and cannot, at the present production cost of electricity, be produced on a competitive basis against the petroleum-based equivalent groups, which are in a comparatively advanced state of development in the United States. If, therefore, Britain is to become a world competitor in plastics—and on this depends the extent of her service to Europe and other oversea markets—she must modify by some means the subsidiary costs of production of coal-based plastics, or she must erect oil-refining plants so that she may establish a large production in the oil-based groups. And both these processes are going to take considerable money, labor, materials, and time.

Nor is it to be supposed that it will be easy for industrial concerns to make a decision about the scope of their intentions in the plastics field. Plastics have been promoted to a front place in the awareness of investors and pictures of their more trivial applications fill the illustrated magazines. But even today, on the basis of weight, the world output is only one-quarter of one per cent of the world's steel output. It has been easy to take a rosy view of the plastics outlook in conditions that have made steel a precious metal and timber a luxury, but if the Atlantic Charter means anything it means that steel will not be that rare in the post war, or timber that precious.

END

ENGINEERING
News Letter

By **LEWIS WINNER**
Market Research Engineer

Applications . . . Methods . . . Materials

The measurement of the dielectric constant and loss of solid materials at very high frequencies or in the frequency range of from 50 to 1000 megacycles, has always been a difficult project. This has been due to the residual lead and electrode inductance, resistance and capacitance, and the difficulty of obtaining a solid sample to conform to the shape of the measuring device.

This problem has been solved by a resonant cavity method developed by C. N. Works, T. W. Dakin, and F. W. Boggs of Westinghouse Research Laboratories. The process was described by these experts at the recent meeting of the American Institute of Electrical Engineers at St. Louis.

A re-entrant cylindrical cavity has been adapted to measure the dielectric constant and power factor of small disc samples. The unit operates in frequency range of 150 to 300 megacycles, and 400 to 600 megacycles. Higher frequency equipment is possible, and is being built. Electronic procedure is used to secure the resultant factors, the equipment consisting of a wavemeter in which is included a calibrated oscillator or signal generator. Frequency modulation in conjunction with an oscillograph is also employed, in this instance, to determine the dissipation factor.

The accuracy obtained with this method of measurement was stated to be about plus or minus .00005 in tangent δ, and about plus or minus 1% with optimum size sample, in dielectric constant. According to the designers of this equipment, its accuracy is dependent upon the assumption that the universal resonance curve holds for the cavity as arranged with a coupling loop and feeding line. In other words, say these engineers, the voltage variations in the cavity are assumed to correspond to frequency changes of the oscillator source, according to the resonance curve of the cavity. These variations are independent of coupling elements.

In typical measurements made at about 200 megacycles, the following data was obtained:

Measurement of the Dielectric Contact and Dissipation Factor
Measurement Made at About 200 Megacycles

	Thickness, Inches	Dielectric Constant	Dissipation Factor
Micarta No. 254 (cresol-formaldehyde resin, paper-filled)	0.150	3.72	0.047
Columbia resin CR-39	0.149	2.96	0.027
Polystyrene (Sample A)	0.150	2.55	0.0003
Polystyrene (Sample A)	0.100	2.565	0.0003
Polystyrene (Sample A)	0.250	2.56	0.0003
Polystyrene (Sample B)	0.151	2.56	0.0005
Polyvinyl Carbazole	0.115	3.06	0.0009
Special Styrene Copolymer	0.183	2.64	0.008

Trade Marks

Trade marks registered in the U. S. Patent Office during the past weeks include: Plastool, R & R Plastics, Inc., West Springfield, Mass.; Plastifoam and Pliofoam (for thermo and sound insulating material containing a urea formaldehyde resin in sheet or bulk form), Goodyear Tire & Rubber Company, Akron, Ohio; Mosstypes (for rubber printing plates and dies, and plastic printing plates), Theodore Moss Company, Brooklyn, New York; and Co-Ro-Lite (for resin-impregnated vegetable fibre material in sheet form or in shapes cut therefrom for molding), Columbian Rope Company, Auburn, New York.

Patents

Making hollow thermoplastic ware, patent 2348738, Victor E. Hofmann, Toledo, assignee, Owens-Illinois Glass Company, Toledo.

END

THE SHAPE OF THINGS TO COME

While the House Of Plastics is today engaged 100% in vital production we are reserving no small part of our time in planning for post-war plastics fabrication. So, whether your needs be only simple store displayers, or elaborate architectural effects, remember that the House Of Plastics has plans for fabrications that will meet your post-war requirements adequately and well. Consultation on post-war industrial design invited.

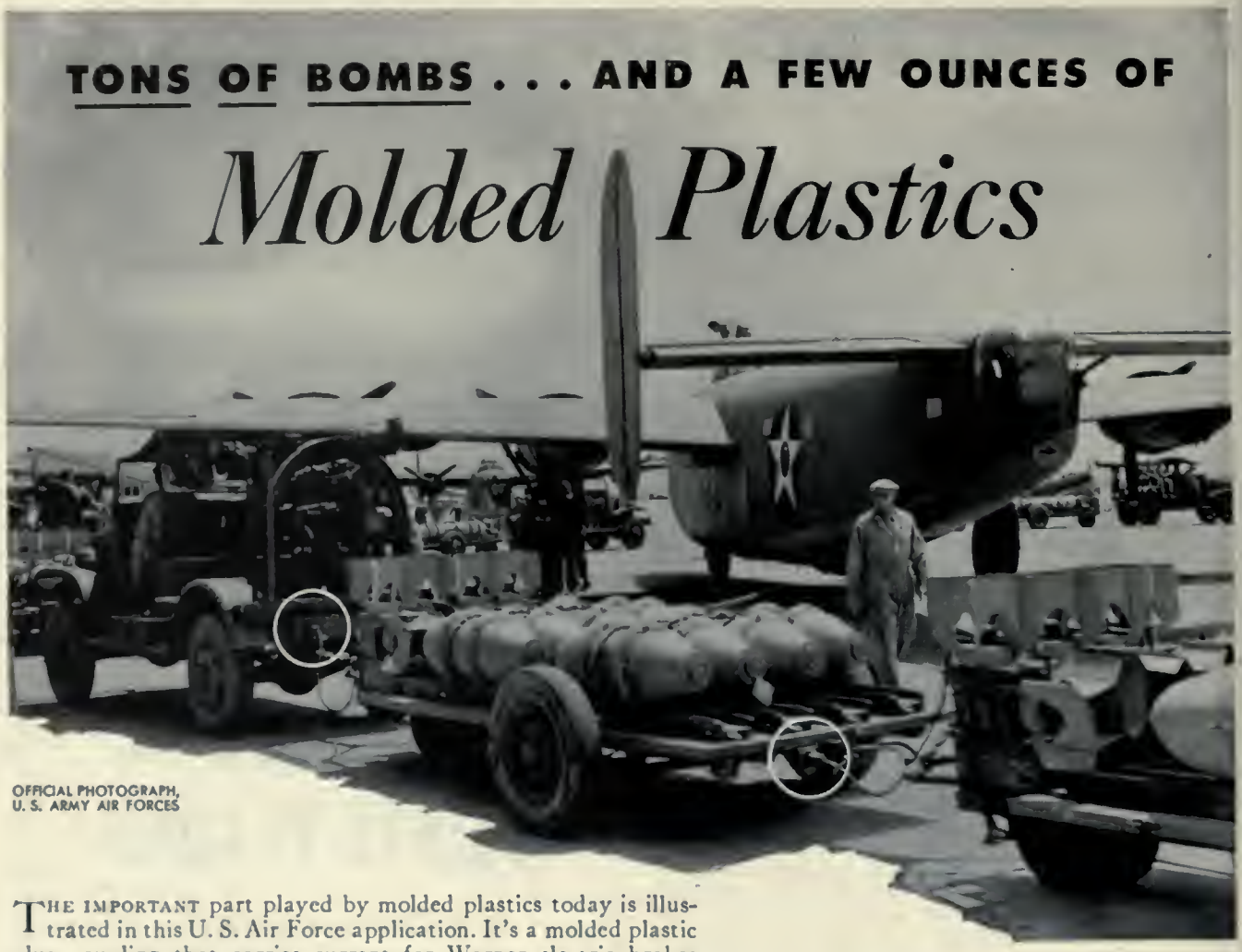
HOUSE OF *Plastics*

SPECIALISTS IN PLASTIC FABRICATION AND DESIGN

1720 Euclid Ave. Cleveland, Ohio

TONS OF BOMBS . . . AND A FEW OUNCES OF

Molded Plastics



OFFICIAL PHOTOGRAPH,
U. S. ARMY AIR FORCES

THE IMPORTANT part played by molded plastics today is illustrated in this U. S. Air Force application. It's a molded plastic plug coupling that carries current for Warner electric brakes from tractor to trailer. It weighs only a few ounces, but upon it depends the safe handling of tons of bombs.

These couplings, molded by CMPC for Warner Electric Brake Manufacturing Company, are proving their value in dozens of similar applications. They've a tough job to do . . . and they're doing it . . . day in and day out. Molded of high impact phenolic material, they demonstrate the ability of CMPC to tackle even the toughest problems and come up with the right answer.

This is another example of the importance of choosing the right plastic molder . . . one who can see the job through from design through mold-making, molding, and finishing . . . one who has complete facilities and proven ability to take full and undivided responsibility for the production of a vital part of your product . . . and can time his deliveries in accordance with your production schedules.

Ours is the largest and best equipped custom molding plant in the Middle West, with a national reputation for quality and service. A CMPC Development Engineer will gladly work with you in your planning for postwar products. Write today . . . there's no obligation.

The Warner Coupling Socket with general purpose phenolic insert in metal housing.

The Warner four conductor, plug-in coupling, each component molded of high-impact, macerated canvas phenolic material.

CHICAGO MOLDED PRODUCTS CORPORATION

Precision Plastic Molding

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COMPRESSION, INJECTION AND TRANSFER MOLDING OF ALL PLASTIC MATERIALS

25 years of Progress and Achievement

WHAT'S *New* IN PLASTICS

hellac Stronger Than Steel

'estinghouse Electric & Mfg. Company
ıst Pittsburgh, Pennsylvania

A synthetic shellac so strong that a ır of it 1" in cross-section would support 40-ton locomotive suspended from one ıd.

Considered superior to natural shellac, ıc material replaces it as well and is escribed as having none of the impuri-es characteristic of the natural product. 'romises also to eliminate mica used with hellac for commutators.

Chief properties are unusual elasticity and strength. For example, a fiber-glass bonded with the resin has a tensile and bending strength equal to that of strong metals—75 to 80,000 psi—better than iron, which has a tensile strength of 15-50,000 psi, sheet brass with 40-70,000 psi, and many steels, which rate 80-300,-000 psi. .....(49)

Injection Molding Machine

Lester-Phoenix, Inc.
Cleveland, Ohio

Three types of injection molding are performed by the machine: One using thermoplastic materials; another for thermosetting materials and rubber compounds using the "jet" process; and a third for electronically-heated pre-forms in plastics or rubber (Photo right).

Known as Model 3V-12, the machine is built in a vertical design with horizontal die platens, which prevents inserts from falling out or shaking loose. Dies are easier to change and mount in the press, vertical injection cylinders can be filled more completely, and wear and drag of horizontal cylinders is eliminated.

Injection molding of thermosetting material and rubber can be done either by jet injection of granular material or plunger injection of electronically-heated pre-forms, depending on the weight and size of the castings. The former is usually used for those up to 12 oz. In both methods, cycle time is reduced to a fraction (from ½ to 1/50) the time required by previous methods, and investment in dies and presses is considerably less. The frame provides 400 tons of die clamping pressure. Die opening and closing is by hydraulically-actuated double toggle linkage with hardened cam and wedge locks to insure rigid metal-to-metal die support. Total weight is about 19,500 lb. ....(50)

To simplify for our readers the task of obtaining detailed information regarding the new products, processes and trade literature described herein, PLASTICS offers the prepaid postcard inserted at the left.

In rapidly-moving times such as these, keeping up with every latest development in one's field is a "must." War's insatiable demand for swifter production, and the competitive drive toward lower manufacturing costs require that all avenues leading to a solution of these problems should be explored thoroughly.

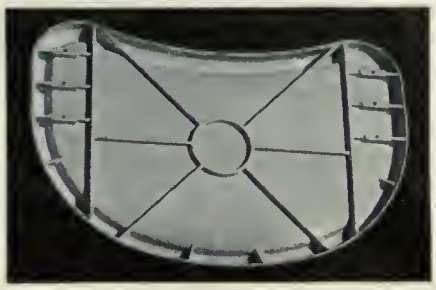
Each item in this section is keyed with a number, which should be entered on the postcard to facilitate identifying the exact product, process or publication about which information is desired.

High-Chair Tray

Fred Skinner
Los Angeles, California

A plastic tray for infants' high-chairs has been compression-molded by F. E. Reinhold, Los Angeles, for Fred Skinner, using *Makalot Kem*, American Cyanamid urea, and *Melmac*. Purpose is to replace scarce lumber.

The upper right photo shows the supporting ridges of the underside of the tray to give added strength and eliminate warping. The materials used provide excellent surface finish, attractive colors, long life and resistance to mild acids and alkalis. The unit is designed to accommodate standard hardware. Weight is about 2¼ lb. ..... (51)



High Frequency Insulator

Monsanto Chemical Company
St. Louis, Missouri

Low dielectric constant and power factor characterize *Resinox 7934*, new and improved phenolic molding compound produced by the firm for use with high frequency apparatus.

The material also has low water and moisture absorption and relatively high heat resistance. It is a mica-filled phenol formaldehyde resin. .....(52)

Phosphorescent Pigment

The New Jersey Zinc Sales Company
New York, New York

Emits a brighter phosphorescent afterglow for a longer period of time than similar types of pigments. It is designated CAS-SrS-2470, and is intended for use in marking tapes and decalcomanias, and in phosphorescent paints. .....(53)

Plastic Hose Nozzle

Plastic Die and Tool Corporation
Los Angeles, California

Incorporates an entirely new principle of spray control. A quarter turn provides full range of adjustment from spray to direct stream.

The plastic, known as *Durabrite*, unlike the conventional nozzle, gives a full flow of water at any adjustment, thus preventing any back pressure which might burst a connection or the hose itself.

Durabrite is rust-proof, and is made from a type of acetate that does not crack or chip. .....(54)

Hoods Made of Single Sheets

E. I. duPont de Nemours and Company
Wilmington, Delaware

Single sheets of *Lucite* methyl methacrylate resin are used in a new method to form teardrop shaped canopies for cockpits. Held at the edges by a ring which controls the ultimate shape of the piece, the heated plastic is forced by air pressure to take the shape of a teardrop, in a manner similar to that of blowing soap bubbles.

Known as "free-blowing," this method eliminates direct pressure of molds on the plastic and produces canopies with reduced optical distortion and permit rear vision. The enclosure is standard equipment on present North American P-51 *Mustangs*. .....(55)

Tape Repairs Veneers

Resinous Products & Chemical Co.
Philadelphia, Pennsylvania

A weatherproof tape to repair split or cracked thin veneers, *Tego* tape is said to solve the problem of salvaging many veneers which might otherwise be discarded. It is a thermosetting resin of the phenol-formaldehyde type, restoring mechanical strength of the original without impairing weather resistance.

It may be used to repair splits along grains which occur during handling of thin plywood veneers in the assembly and press loading operations. Only 10-15% of all plywood veneers delivered to plywood manufacturers have proved suited to the rigid requirements of aircraft construction —a condition which the producers of *Tego* hope to remedy. (Photo right.)

It can be used for splits in veneers having compound curvatures. .....(56)

Water-Soluble Coumarone

The Neville Co.
Pittsburgh, Pennsylvania

A water-soluble coumarone-indene resin emulsion, termed *Nevilloid* C-55, is offered by the company, which describes it as the first such emulsion to be offered commercially.

The emulsion will stand dilution with water, can be cooled to 10° F and heated to 77° F for three cycles without showing a break, is continuous and cohesive, will withstand considerable flexing, and possesses valuable properties for use with latex. It can be incorporated with latices

of natural rubber, GR-S or *Hycar* OR without prior dilution or causing coagulation of the rubber by the addition of a 10% sodium hydroxide solution only, in such amount as to give a pH of 10. A typical mix by volume consists of 20 parts *Nevilloid* C-55, 2 parts 10% aqueous sodium hydroxide and 20 parts latex.

The emulsion blends with alkyd resin emulsions of various types without pretreatment, giving uniform, but somewhat opaque films. The product is 65% solid by weight, has a specific gravity (50% by weight solution in distilled water) of 1.044 to 1.049 at 15.6/15.6° C; produces on glass a semi-gloss film, free from grains, slightly tacky and translucent from a 50% aqueous solution; has an isoelectric point of about 2.9; and has a pH of 6.5 to 7.5, the emulsion being stable over a wide range of pH, from about 3.5 to 10.5. .....(57)

New Lucite Applications

E. I. duPont de Nemours & Co.
Wilmington, Delaware

Lucite methyl methacrylate resin has been applied to parts of aircraft inclinometers, rate-of-climb indicators and relay boxes by the company. *Lucite* combines transparency which is an aid to maintenance, with toughness, resistance to breakage, and low cost in comparison with material replaced by it.

One user reported a reduction of 50c per unit in the cost of manufacturing the inclinometer, while savings on the rate-of-climb indicator reportedly runs up to $40 per unit. Extreme accuracy is important in these instruments, with tolerances of .0005" not uncommon. The inclinometer is molded in one piece, while the rate-of-climb indicator is assembled from four separate plastic parts, including two long, tapered indicating tubes, molded as integral parts of the body. .....(58)

Tenite for Switch Panels

Tennessee Eastman Corp.
Kingsport, Tennessee

Extruded tenite sheet is used for switch plates and panels needed by the automotive and aviation industries. A special feature is the use of depression lettering molded into the sheets, which is filled with a synthetic resin base material of suitable color. The plates (left) are made by shearing or die cutting. The material is flexible and will follow any contour, yet is tough enough to permit stamping of serial numbers and modifications on the plates. Weather resistance, dimensional stability and resistance to petroleum products and de-icing fluids are described as outstanding. ..... (59)

Collapsible Rubber Maps

United States Rubber Company
New York, New York

Planning landing operations is expedited through the use of collapsible rubber contour maps of enemy coastlines, showing gun emplacements and pillboxes, along with natural landmarks.

From the original model a plaster negative is cast, which is then sprayed with latex, reinforced, cured and stripped from the mold and colored to simulate the actual landscape. .....(60)

Dummy Spark Plugs

Continental Plastics Corporation
Chicago, Illinois

Answering the need for dummy spark plugs to keep dust, dirt, bolts and other materials out of engine cylinders during engine assembly, disassembly or servicing, this product is a molded thermoplastic, cellulose butyrate, with high impact and tensile strength. It is colored bright yellow to conform to assembly and production control colors and consists of seven parts, three injection molded in a three-cavity cam-action mold (photo below).

The three cavities mold all the parts complete, each shot at the rate of about 80 shots per hr and at a molding temperature of 350-52° F. Shrinkage is avoided by plunging hot moldings into cool water immediately after removal from the die.

Finishing operations, including riveting, cementing and assembly are all completed at the plant. The finished plug is a stock item offered to airplane manufacturers and repair depots in minimum lots of 25.

Low in cost and easily installed, the dummy plug need not be unscrewed or removed to permit the crankshaft to turn freely. It holds ignition leads in place at all times, eliminating the need for taking wires off when assembling, installing, removing or disassembling the plug. The plug can even be removed from the hole without unscrewing, by means of a spring action lever and a split thread. Pressing the lever on the plug causes the divided thread of the plug to disengage from the engine-block threads. To insert the plug, the lever which actuates the split thread is pressed, causing the dummy thread to engage that of the engine-block without turning. .....(61)

Moisture-Proof Plastic

Westinghouse Electric & Mfg. Company
East Pittsburgh, Pennsylvania

Meets need for moisture-proof coating of radar and other communications equipment for the armed forces. The material has the twin advantage of being able to fill every small recess and at the same time require no solvent that would boil off with heat.

The photo above shows an electrical transformer enclosed in a "skin" of *Fosterite* and submerged in water. Even when left in this condition for as long as 6 months, the light continued to glow.

The new material has also successfully withstood severe tests, such as subjection to extremes of temperature, vibration (1000 times per min for 1 hr, 20 min). It is almost as fluid as water.

During the impregnation of a coil or other device *Fosterite* is in a liquid state, but the liquid resin reacts with another resin dissolved in it,, the entire mass polymerizing into a tough solid. There are no by-products of the reaction which must escape. The resin is actually a family of resins, which makes it possible to obtain a wide range of properties by suitable modifications. The complete filling allows a much higher voltage gradients to be used than hitherto. Fosterite providing 4 to 5 times the dielectric strength of other materials on one small radio transformer. This permits a radical reduction in size and weight. Elimination of voids increases heat conductivity of the structure. Moisture-proofness is 100 to 1000 times better than with the best previous material, according to the company. .....(62)

Improve Natural Fibers

Monsanto Chemical Company
St. Louis, Missouri

Treatments recently developed by the company accomplish the following:

1. Prevent wool from shrinking.
2. Improve wearing qualities of wool and cotton.
3. Eliminate shine from serges.
4. Improve creasing property of wool.
5. Prevent stockings from running and their seams from pulling out. ..(63)

High-Frequency Preheating

Girdler Corp., Thermex Div.
Louisville, Kentucky

The firm has developed No. 2-P *Thermex*, operating at a frequency of 25-30 megacycles, to meet the demand for automatic high-frequency equipment for preheating plastic preforms. (Illustrated in above photo).

Using 230 v, 60-cycle, single-phase current, the model has an output of more than 3400 Btu per hr. It is compact and contains a built-in heating cabinet and removable 12 × 15″ drawer-electrode. There are no dials, no tuning, no buttons to push. Closing the preform drawer all the way turns on the high-frequency power and timer. At the end of the prescribed time, a red indicating light goes out and the tray is removed. .....(64)

Literature Review

Plastics' War Contribution

Dillon-Beck Manufacturing Co.
Irvington, New Jersey

Case histories of products developed by the company to further the war effort are cited in this folder, presented in the form of newspaper tear-sheets.

Among these are the plastic assembly parts of a sound locator for the armed services. The aluminum case must be thoroughly soundproofed, the insulation being cemented in with liquid plastic and the horn being finished with a preparation protecting it against temperature changes and adverse weather. Other examples include plastic shipping plugs and thread protectors produced for Curtiss-Wright; an all-plastic sextant; a plastic rain gage based on an entirely new principle, supplanting the age-old method of dipping a measuring stick into an open container; and a collapsible, non-corroding plastic razor. .....(65)

Information on Formica

The Formica Insulation Co.
Cincinnati, Ohio

"What Formica Is" is the title of a booklet issued by the company with a view to explaining the wide variety of uses to which this product can be put. Principal characteristics upon which its appeal is based, it is pointed out, are high dielectric strength, high surface and volume resistance, low power factor, low moisture absorption, high mechanical strength and dimensional stability, low coefficient of thermal expansion, inertness, ability to withstand exposure to the action of solvents, mild alkalies and acids, colorability, infusibility and durability.

Formica is shown to have extensive application in the field of radio, automotive and electrical products, X-ray, chemistry, plating, gears and decoration. One special type of formica is able to dissipate the burning effect of cigarettes, matches and cigars; other types are translucent; some are verichromed by application of a printed design to the surface; and tubing is available which has a tensile strength (1"16" wall) of 12,000 psi. .....(66)

Encyclopedia of Substitutes and Synthetics

Edited by Morris D. Schoengold

A valuable list of the most important products in its field, with strong emphasis on plastics. Included under most product names is not only a description of the material and its method of production, but also a list of properties and statements as to its solubility, uses, substitutes, and other similarly significant facts.

The one thing lacking is the name of the company producing those items listed by trade name. An example of the way in which items are handled, is *Aquaresin*. This is described as the trade name for a product which consists of glycol bori-borate, an odorless, water-white viscous liquid which is non-drying. Uses listed include the plasticizing of glues, gelatine, gums and resins.

In some cases, the chemical formula for the material is given. Where the name covers a variety of products, the properties of individual products are not listed.

382 pages, illustrated $10.00. .....(67)

"Plyophen" for Aircraft Tooling

Reichhold Chemicals, Inc.
Detroit, Michigan

Plyophen casting resins save critical metals and speed-up tool making at Consolidated Vultee Aircraft Corp., according to Reichhold Chemicals, Inc.

When expert tool and die makers became scarce, the aircraft company had to find another means of fabricating tools. Among the more recent and least known applications of *Plyophen* is casting to form plastic tools and dies for metal-forming operations. This has made possible reduced use of aluminum, steel, dural, zinc alloys, lead and other metals, and decreased number of man-hours of skilled workmen. The latter resulted chiefly from the fact that cast phenolic resins conform to molds and do not require machining or further working after they have hardened. ..(68)

The Chemistry of Synthetic Substances

By Dr. Emil Dreher
Philosophical Library, New York City

A broad discussion of many chemical problems affecting the plastics industry, written by a German author and translated by Marion Lee Taylor.

Approaching the subject from a theoretical point of view, the author begins with an outline of high molecular organic compounds, then proceeds to survey the relations of synthetic high molecular compounds of drying oils; discusses the principles of polymerization, the development of the chemistry of high molecular organic compounds, various types of products of polymerization, the influence of constitution on the capacity for polymerization of low molecular compounds, the influence of substituents on the capacity for polymerization of low molecular compounds, the principles of the polycondensation processes, and the solubility of high molecular film-forming substances.

103 pages, illustrated—$3.00. .....(69)

Resin Bonds Heavy Lumber

Resinous Products & Chemical Co.
Philadelphia, Pennsylvania

Amberlite PR-75-B, for use with catalyst P-79, announced by the company in a new folder, is described as a temperature-curing phenol formaldehyde adhesive. It provides a means of obtaining at dry kiln temperatures, such as 140° F, glue joints having the strength and durability characterists of such phenolic adhesives as *Tego* No. 2 and *Amberlite* PR-14.

It can be used for bonding a wide range of lumber and timber constructions, such as oak ship keels and laminated structural members for columns, timbers, arches and trusses, in addition to such aircraft applications as wing and fuselage assembly gluing, hollow spar construction, and scarf jointing. .....(70)

Electric and Air-Driven Sanders

Sterling Tool Products Company
Chicago, Illinois

Both electric and air-driven sanding equipment are described in new literature issued by the firm. Application of both to plastics is covered.

The air-driven speed-bloc model is designed to operate on only 60 lb pressure using about 6 cu ft of compressed air per min under load, making more than 3000 back-and-forth strokes per min. Releasing the machine from work automatically shuts off the power. The unit is automatically self-oiling, has a pressure regulator, and comes with a portable steel tray mounted on casters for portability. A pliable sanding bloc makes it possible to sand curved surfaces. The unit sands either wet or dry. .....(71)

Clorafin 42 Plasticizer

Hercules Powder Company
Wilmington, Delaware

Unusual properties of the plasticizer *Clorafin* 42, and the resin, *Clorafin* 70, are described in the company's latest booklet. No. 42 is a light-amber, viscous, nonflammable material which emulsifies easily and acts as a good plasticizer for some vinyl resins. No. 70 is a pale straw-colored, hard, brittle resin with even better flame-extinguishing characteristics than No. 42. It is used for making flameproof and waterproof coatings and adhesives. The name is derived from the fact that the product is made of chlorinated paraffin. No. 42 containing 42-43% chlorine, and No. 70 69-72% chlorine. .....(72)

Pressure Processing

The Hydraulic Press Mfg. Company
Mount Gilead, Ohio

Written expressly for the post-war planner, particularly those with little or no association with the industry proper, this bulletin outlines the role of pressure processing in handling synthetic resins, stressing the adaptability of plastics materials to a wide range of products.

Various types of plastics are explained. Numerous illustrations are provided. (73)

INDUSTRY HIGHLIGHTS

Increase Electronic Heating

Despite its comparatively high cost, electronic heating is finding increasing use in the plastics industry.

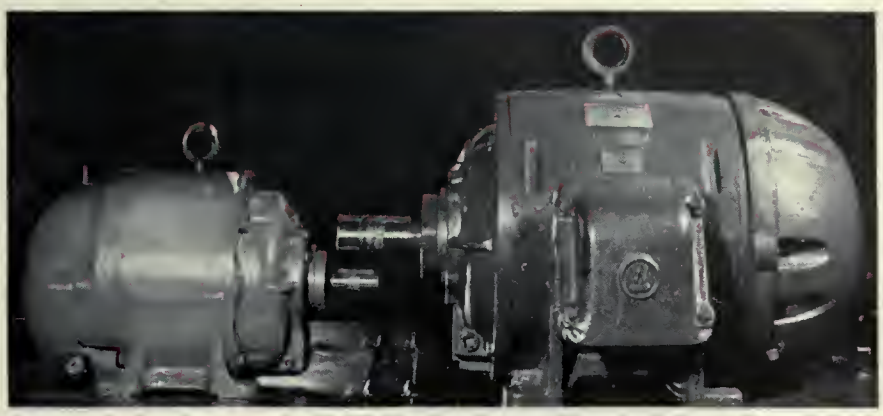
An example is found in the molding of asbestos-filled phenolic-compound welding rod holder tips, where impact strength and heat resistance have to be high. By using electronic methods, heating the preforms is cut from 20 to 1½ min; core temperature of preforms is raised from 150° to 325° F; closing time is reduced from 1½ min to 20 sec; and curing time drops from 15 to 5 min. Six tips can now be molded at one time from a 1-lb preform.

●

Weight of electrical equipment can be cut as much as 50% through the use of *Silicone* insulating varnishes, according to Westinghouse Electric & Manufacturing Co. This is particularly applicable to cases in which design limitations are determined by insulating temperatures. A substantial increase in the output of small motors (see photo) using the same frame is also possible, and motors are able to operate at higher ambient temperatures. *Silicone* is described as a high-temperature insulation having exceptional thermal stability.

●

Organization of Grayhill, a company to manufacture mechanical and electrical switching devices for the electrical, electronic and aircraft industries, is announced by W. S. Lewis, chief mechanical engineer and general manager. Offices are at 1 N. Pulaski Rd., Chicago, and manufacturing plant at La Grange, Ill. Arnold Wassell is in charge of producing the plastic parts used in the company's products, and has been doing development work on low-pressure molding of phenolic-impregnated fabrics, paper and glass cloth, which offers low mold cost for large pieces.



Both the 210-lb motor on left and 410-lb motor on right produce 10 hp at 1750 rpm. Insulated with "Silicone," smaller is capable of operating at higher temperature

Two war materials developed by the former German General Aniline & Film Corp., a seized alien property now completely Americanized, have been put to use in the invasion, it is reported. One is a group of *Polectron* resins, the other carbonyl iron powder, both important in the production of radio and other electronic equipment.

Carbonyl iron powder is used for cores in radio equipment. Development of *Polectron* products has made possible the manufacture of improved paper condensers.

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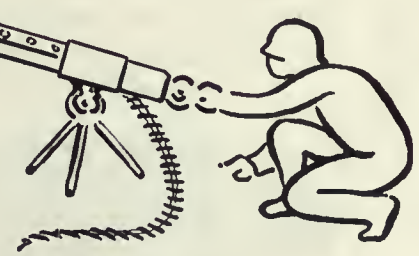

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Vinsol resin and Truline binder have been removed from allocation by the WPB, it is announced by Hercules Powder Co. *Vinsol* resin has been used in asphalt emulsions for military airport and road construction and in production of plastics and paperboard, replacing more strategic materials. Before the war, it was also used in making air-entraining Portland and masonry cements, emulsions, paint, varnish, linoleum, rubber, ink, adhesives and leather. *Truline* binder finds wide use in cores and molds by foundries producing castings of all metals, and as an extender for cereal binders and linseed oil.

●

Dimensional stability at high humidities may be achieved by using glass and asbestos cloth in laminated plastic material, according to a paper delivered by A. C. Titus, chemist at the Schenectady Works Laboratory of General Electric Co. before the aviation-rubber and plastics division of the American Society of Mechanical Engineers in Pittsburgh recently.

Weight change measurements, he emphasized, are not true reflections of dimensional changes. With cotton-filled molded plastics and with cotton cloth laminated plastics in particular, he concluded, removal of water does not stop further dimensional shrinkage on heating.

Dimensional changes due to moisture absorption in laminated plastic products are closely related to the type of filler employed. Cotton rag filled with phenolic plastic instrument bases could be dehydrated in the oven at 150° C within 24 hr., but required over seven times as long at 80° C. Continual shrinkage occurred beyond the dry state at either temperature. No upper limit was even approached in 2 months at 100% RH.

●

Synthetic elastomers are being produced by a new company, Resin Industries of Santa Barbara, Calif., which plans to serve aircraft, shipbuilding and allied industries on the West Coast. Products will include vinyl resin, ethyl cellulose and similar materials in tubing, tape, sheet and other forms, and in combination with a variety of fabrics, coated and impregnated.

●

World rubber demand may rise to 1,900,000 long tons by 1950, of which 1,075,000 will be produced by American synthetic rubber plants, according to R. P. Dinsmore, vice-president in charge of research and development, The Goodyear Tire & Rubber Co.

He predicted a U. S. civilian need of 1,010,000 tons in 1948, as against the nation's highest previous consumption of 783,000 tons in 1941. He estimated that reclamation of the world's natural rubber areas will not yield more than 400,000 tons of rubber in the first year of effect, and not more than 700,000 tons the second year. The world will face a "tight rubber situation for nearly 4 years after the war unless we expand our synthetic rubber output further," he asserted. As it was, he added, we built our synthetic rubber plants "just in the nick of time" to take up the burden of the exhausted crude rubber supply.

Among inroads to be made by synthetic rubber after the war, he listed rubber spring suspensions to replace steel springs for autos, vibration dampeners for industrial machinery and railroad trains, latex sponge rubber for cushioning furniture, and rubber as a base for lacquer, adhesives, plastics and packaging materials.

●

The Chemicals Bureau of the WPB has been requested to prepare a list of plasticizers made from other than phthalic anhydride that are available in order to complete military requirements and to partially satisfy civilian needs for baby crib sheeting, hospital sheeting, shoes, shower curtains, and rainwear. The list will be available soon. Because of the critically short supplies of phthalic anhydride used in the production of plasticizers for pyroxylin and vinyl resin coated fabrics, military end-uses for these coated fabrics were cut for July, leaving none available for civilian requirements.

●

B. F. Goodrich Co. is expanding its chemical plant to boost production of *Geon* vinyl chloride resins at the request of the WPB. These are used for insulation and sheathing of cable.

association activities

Surplus Clearing House

In order to aid the plastics industry in the speedy disposition of surplus materials resulting from war contract termination, the Society of the Plastics Industry plans to issue a monthly listing of these materials based on data submitted by manufacturers.

The bulletin, as proposed by SPI, would describe the products offered for sale, identified with a key number representing the source. Those interested in purchasing the material would clear through SPI.

To expedite its movc, the society has sent out questionnaire forms on which companies may list their product, model number, color, supplier, number of pounds, quantity and other information.

Cites Plastics Gains

The tremendous strides made by the plastics industry during wartime were outlined in a talk presented by William T. Cruse, vice-president of the SPI, before the joint conference of the SPI and the Douglas Fir Plywood Association held recently in Seattle.

He called attention to the large increase in poundage produced by the industry in 1943 over 1942, the total for the former being 900,000,000 lb, as against 468,730,000 for the latter. Of the weight in plastics produced during 1943, 283,000,000 lb were of phenol formaldehyde resins; 123,600,000 of urea formaldehyde and *Melamine;* cellulose plastics accounted for 149,300,000 lb; and vinyl plastics for 86,000,000 lb.

Production of monomeric styrene in 1944 is expected to reach 400,000 lb, Mr. Cruse declared, urging all those interested in the future development of the industry to follow the progress of this low-cost material closely. At present, hc pointed out, because it is employed in the synthesis of *Buna S* rubber, it has not been generally available to the industry.

He cited the contribution of polyethylene to the development of radar; *Lamanic* and allyl alcohol to the field of laminates; and the suitability of arc-resisting *Melamine* to the manufacture of housings for electrical equipment.

Production of the plastic M-52 fuse, he stated, has been tremendous, with more than 10 companies engaged in its production. Housings for binoculars are now manufactured largely of molded plastics.

Discuss "Reanite," "Duralon"

The value of *Reanite* was discussed by D. F. Siddall, director of research, U. S. Stoneware Co., Akron, O., before a recent meeting of the Cleveland section, Society of Plastics Engineers.

He stressed its strength, its fast drying time, ease of application, strength retention under varying conditions, economy, color maintenance, resistance to corrosion and fungus growth, and ability to keep well in storage. It is applied by brush, spray, dip or roller, and can bc used to adhere plastics to metal, glass, rubber, ceramics and other materials.

He described *Duralon* resins as being extremely versatile, and capable of use as a surface coating, varnish ingredients, casting resins, laminating and impregnating agents and molding resins.

Next meeting of the section will occur Friday, September 29.

Creates Research Fund

An initial fund of $100,000 has been set up by the Douglas Fir Plywood Association of Tacoma, Washington, to support its newly-created research foundation for plywood products.

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If you're not quite sure just how Plastic Molding may fit into your after-the-war picture, why not contact an organization whose principal has had literally a lifetime of experience solving molding problems for others? Submit your rough ideas to us. We'll help you with plans, and figure the cost. You'll get an honest appraisal of the possibilities, and we'll turn out a job of which both of us can be proud.

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Secret lighting and dial developments for U. S. Navy which have become a must and are now used.

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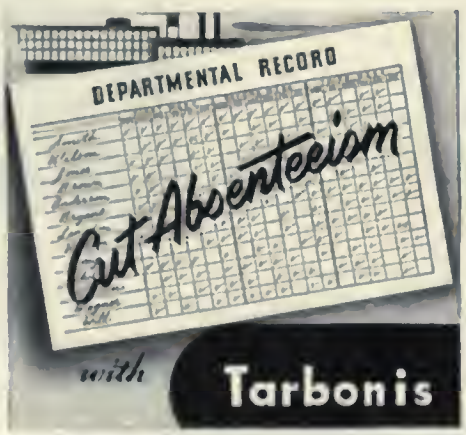

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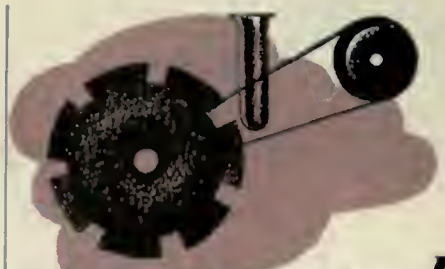

PROBLEMS in *plastics*

Problems and questions may be submitted to this department for answering by the technical editors or specialists in the industry.

At present we are manufacturing living room furniture with carvings nailed through the material on to the frame. If these carvings were made of plastics, could holes be drilled in them at the proper places so that the nails would go through? Would the plastic stand the shock of hammering to countersink the nail? *L. M., Chicago, Ill.*

A suggested method is to mold the plastic carving with studs which will fit into holes drilled in the furniture. Then by the use of a plastic adhesive, fasten these carvings to the furniture, applying the plastic adhesive to the studs on the molded carving and then press it in place in the furniture.

* * *

I would like to make plastics my career, but know nothing about these materials. Could you please suggest some appropriate reading matter?

Cpl. L. S., Ft. Benning, Ga.

We suggest that a start along the lines you have in mind can be secured by studying two books on plastics—Industrial Plastics by Simonds and Plastics for Industrial Use by Sosso. Each of these books emphasizes the molding of plastics together with the physical and chemical properties of the plastics a great deal more than the chemistry of the plastics materials. A more extended book is Handbook of Plastics by Simonds and Ellis.

* * *

I am interested in knowing what you think of the opportunities for careers in plastics, with emphasis on plastics design. Please advise. *B. H., Los Angeles, Calif.*

It is our opinion that there will be many opportunities for careers in plastics design. If one contemplates such a career a good starting point would be a study of the physical, chemical and mechanical properties of the various plastics in order to have a satisfactory background as to what may be done with them, particularly in the lines of forming a finished plastic, and possibly the finishing of the formed plastic.

* * *

Can decalcomania transfer be used satisfactorily in the identification or decoration of plastic objects?

R. E. L., Chicago, Ill.

The opinion is that it can be used in any instance where decalcomania identification or decoration is satisfactorily made when an article is fabricated from other materials. A limited amount of investigation would make it just as satisfactory on plastic objects.

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es in the Virginia nt, Hercules Powder d by **Lloyd Kitchel**, clude appointment of as assistant general es **H. Lickle** as man- rchases.

W. C. Hardesty

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PEOPLE

Russell H. Dunham has resigned as chairman of the board of directors of Hercules Powder Company, a post he had held since the founding of the firm in 1913. He held the offices of both president and chairman of the board until March, 1939, when he resigned the former position. He will remain a director and as chairman of the finance committee.

Charles A. Higgins, replaces Mr. Dunham as chairman of the board, while retaining his position as president.

•

The American Chemical Society's $1000 award in pure chemistry for 1944 will be given to **Dr. Arthur C. Cope,** 35, associate professor of chemistry at Columbia University, when the society meets in New York September 11-15.

Dr. Cope's work is considered of outstanding value in the fields of plastics and drugs. He has published more than 30 papers in organic chemistry, including a study of vinyl and allyl types and the general field of condensation reactions and rearrangements.

Personnel changes in the Virginia Cellulose Department, Hercules Powder Company, announced by **Lloyd Kitchel,** general manager, include appointment of **Elmer F. Hinner** as assistant general manager, and **Charles H. Lickle** as manager of cellulose purchases.

S. J. Cohen

W. C. Hardesty

Recently-announced merger of Amecco Chemicals, Inc., with the W. C. Hardesty Company, to form the Hardesty Chemical Company for the production of sebacic acid, capryl alcohol, dibutyl sebacate and other chemicals, has been followed by election of the new officers of the combined firm: **S. J. Cohen** is president; **William C. Hardesty, John Stead** and **H. M. Abbott,** vice-presidents; **F. R. Cantzlaar,** treasurer, and **R. T. Heilpern,** secretary.

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Durable Toys
(*Continued from page 39*)

ing several laminations, letting the material dry at room temperature (heat hastens the cycle), lifting the laminations from the mold, and presto—there is a boat, a canoe or a doll's house.

The next step-up in pressure is achieved when you put an air-tight rubber bag around the mold (over which the laminating material has been previously laid), and then evacuate the bag. By this method atmospheric pressure is utilized. This gives a pressure of about 10 psi, and that adds up to 20,000 lb on a 2000 sq in area, such as might exist on a streamlined scooter.

Note that air pressure is one form of *fluid pressure* and that the pressure is the same on every sq in of the evacuated bag, and at right angles to any part of it. This is a great advantage in molding rounded shapes with compound curvatures such as one might have on a toy airplane.

Along with low-pressure molding, one will hear much about the fluid-pressure technique, a field in which some of the great advances have been made for the benefit of our armed forces during the war years.

In considering fluid pressure, one immediately begins to wonder whether he couldn't get even better results by using pressures higher than 10 psi. Put the same assembly of mold plus plastics plus reinforcement (all wrapped up in a rubber bag) into a glorified pressure cooker—an autoclave—and one has a set-up that will do a real molding job.

At 85 psi steam pressure, which is ample for most low pressure moldings, one achieves a temperature of approximately 300° F. The heat and pressure makes the plastics melt and flow, presses the plastic well into the reinforcing fibres, and after a cooking cycle of only a few minutes, the molding is completed. If the autoclave is large enough one can put in a great many units, cook them all at once, and thereby increase production.

The limitation of the hydraulic press lies in its one direction pressure, as compared with the all-direction pressure of fluid molding. The straight compression press will mold a "V" shape beautifully, but not a deep "U" shape with parallel sides, since there is little sideward pressure. Various ingenious ways have been attempted to produce at least some side pressure in straight compression presses such as cavities filled with BB shot or soft rubber, in fact, anything that gives an element of fluidity to the direction of the force will increase the variety of forms that can be handled in such presses.

Types of Resins and Reinforcements

Although low-pressure molding of reinforced plastics is a new art, already a wide variety of resins and reinforcing agents are being offered. Some of the resins dry to bone-hardness in a few hours.

The heart of the matter is in the reinforcing used, and the sky seems to be the limit. Leading paper manufacturers are already offering phenol-impregnated papers for use in molding. Textiles made of cotton and linen are naturals for laminating. Some companies talk of palmetto fibres, corn stalks and even straw. The synthetic fibres are in this picture too. If nylon makes strong hose and parachutes, it is a safe bet that it will make a wonderful reinforcing material, if not too costly. Cloth woven from glass filaments has produced the strongest laminates to

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date. In short, the stronger the fibre, the stronger the product.

One material the author often works with is *Co-Ro-Lite*, a cordage fibre such as sisal or manila, delivered in the form of a blanket or felt. It comes in various thicknesses impregnated with phenol-formaldehyde or other plastic binders. While paper, canvas and other flat textiles need to be "hand tailored" to fit over compound curves, *Co-Ro-Lite* can be preformed. By putting the blanket into an inexpensive pre-forming press, the curved shape is created before the material goes into the mold. Hence, loading the mold becomes a much faster process, which counts when production costs are added up.

Co-Ro-Lite is a product of the Columbian Rope Co., which has developed many of the new techniques for low pressure molding. Chief Engineer Kenneth Bowen and his associates perfected the molding process for making the first plastic jettison tanks used by the Navy for their Grumman fighters. The largest of these tanks is almost 9 ft long and 2½ ft wide, holds 880 gal of gasoline and has to be strong enough to withstand being catapulted off the deck of a warship with a full load of 7000 lb.

From Tanks to Toys

These jettison tanks are what started us designing toys. We took some of the rejected shells and began experimenting with them for kayaks, catamarans, ice-boats and a number of other items to which their streamlined shape seemed adapted. We exposed jettison tank shells to all kinds of water and weather conditions, and found they stood up better than wood in salt water or fresh. They seem to be worm and insect proof as well as weather and waterproof.

Mr. Bowen built a very fast-sailing catamaran with two of these shells, and this season we are building a larger one with three shells and a larger sail. An outboard motor enthusiast, known to us, has blueprints made for using two of the shells for an outboard racer.

Plastic Boats, a firm in Lake Placid, N. Y., wants to put a fleet of plastic kayaks into every summer camp in the country at half the cost of the kiddie boats now offered. *These kayaks are so light that they float on the water like egg shells. A child can carry one in one hand. Yet they will float the heaviest man.* The amazing thing about these molded objects is that once molded into one piece they will never fall apart again. They won't dent, they won't rust, they won't be affected by water, they will be practically indestructible, yet they will be lighter and stronger than aluminum.

Another feature that should be considered is that one can mold metal or wood parts right into the plastics in the same operation. Once molded in, it stays in permanently.

No Finishing Costs

What about finishing costs? If one has "know how," they will amount to nothing at all. When they come out of the mold, the objects will have the color and finish of several coats of sanded lacquers. Resin, the basis of varnish, comes to the surface in the molding process, takes on any high polish or figured design that is put into the mold, and there is the toy, bright and shining, ready to sell.

The same principle applies to color. One puts the color right into the resin and dispenses with the paint job. The phenols take only red and the darker colors. The brighter colors are obtained by putting the proper pigments into the clear resins. Experiments are now under way to get bright colors over phenolic moldings by spraying the inside of the mold with pigmented plastics that will bake into the product during the molding process.

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Assembling Their Own Toys

Among profitable discoveries toy manufacturers have made in the past few years is the eagerness of boys and their fathers, and in some cases their sisters, to "make their own." The business of supply kits for making small model airplanes, boats and motor cars from partly manufactured parts has reached sizeable proportions. Imagine a toy airplane built like a Link Trainer, that tilts forward, back and sideways by manipulating the control stick.

The same idea might be applied to kiddie furniture with delightful results. Molded units can also be designed for a great variety of small furniture items.

Among possibilities that low pressure molding offers to the toy industry, besides those already mentioned, are doll's houses, aquaplanes, sleds, swing and see-saw seats, playground slides, wheelbarrows, baby carriages, kiddie cars, rocking horses and hobby horses, merry-go-round fixtures, sea sleds, water toboggans, surfboards, miniature golf games, athletic guards, ping pong tables, game tables, doll's trunks, giant blocks, sand boxes, wading pools and pre-manufactured playhouses. END

Inserts for Plastics Parts

(*Continued from page* 20)

Many molders find it desirable to standardize their insert design and invite their customers to make use of these stock parts which may be manufactured in quantity at minimum cost. The accompanying drawing and table show a standard general purpose female insert design which was developed after a considerable study of screw machine and molding problems. No sealing ring is provided in this insert which is designed for flush molding. It is generally necessary to re-tap small inserts after molding since the molding pressure crushes the thread slightly and this re-tapping will also remove any flash that runs into the thread.

Very large inserts may set up strains in the plastics material because of the difference in the rate of shrinkage of the two materials. A latex coating or a preformed "pill" of cloth-filled phenolic around the insert may be used to reduce this breakage and an annealing bake of 12 hr at 235° F may also be helpful. Product designers must consider the possibility of such breakage and make sure that the wall thickness of molding material around the insert is adequate. A simple and safe general rule for the thickness of compound surrounding inserts is to use a minimum of one-half the diameter of the insert.

While it is not possible to produce molded-in-through inserts that will be absolutely tight under pressure without the use of special alloys, such products may be improved by dropping them in water when they are removed from the mold so that the insert will shrink quickly and permit the compound to shrink down to the insert with no gap resulting from the insert shrinking after the compound has stopped shrinking. END

In the September issue of *plastics*

PHENOLIC LAMINATES

A detailed report on the production of laminated phenolics from the standpoint of machinery and equipment used, as well as the various processes employed.

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Post-War Housing
(*Continued from page* 17)

(like Masonite) or a completely plastics bent sheet. (This has reference to another war development, the post-forming of flat laminated stock.) The legs are made from similar materials, and the extreme simplicity of this construction allows rapid production at extremely low cost.

In the bedroom in another illustration, the same hygienic and sanitary materials are used in the sturdy and attractive cabinets as well as the walls.

Note in the center of this design the sliding partition that creates two separate rooms in an instant if this is desired. The beds will use the newly developed attractive and practically indestructible thermoplastic woven materials made from Saran vinylidene chloride plastics extruded filaments. They have been used now for several years on the New York subway cars and in some busses. The Firestone Industrial Products Company has developed such materials as automobile upholstery. These provide extremely pleasant patterns and will not soil, because they are unaffected by any of the materials that they could possibly be exposed to during their lifetime.

In the kitchen shown in another illustration, we see an original version of the much-discussed horizontal refrigerator. The drawer type refrigerator has met with much favor by the post-war planners in this field, because it prevents the spilling out of the cold air on the floor when it is opened. Since cold air is heavier than warm air, it remains inside the drawer, the construction of which is of a transparent plastic, for which purpose polystyrene may be used because of its excellent moisture resistance, although ethyl cellulose or cellulose acetate provide much better impact strength. The plastic tiling on the floor of this kitchen is either compreg wood, so successful in propellers for airplanes, or paper base material, as was used in the living room. It goes without saying that the electric toaster and mixer visible on the plastic sink top are almost entirely built out of plastics.

The bathroom illustrated boasts a highly unconventional bath tub design. At this point, remember that most plastics still must attain a surface hardness comparable to that of vitreous enameled steel. Therefore, if plastics are to be used in units such as wash bowls and bath tubs, the public must be re-educated not to use the now popular scouring compounds for cleaning purposes. If subject only to the simple cleaning treatments that plastics require, they will give excellent service, and can be produced at same or lower costs than cast iron enameled tubs and bowls.

Safety Built Into Tub

Especially interesting is the possibility of making the tub entirely slip-proof, by molding-in grooves, or providing a slightly coarser surface finish. Attention is called toward the shower unit extending above the regulator, and faucet for the tub. It is of such construction that the flexible hose providing the water is coiled up on a reel inside the structure, so that it can be pulled out when in use and may be used either over the bath tub or over the wash basin.

The wall and floor of this bathroom use the sanitary and easily cleaned plastic tiling, and the vinylite shower curtain is practically indestructible.

Sound engineering judgment needs to be used in each investigation of the possible use of plastics in a product, to prevent misapplication. On the whole, however, one cannot help but feel that the surface has only been scratched and that even the most exuberant visions of the future of the industry, will be surpassed long before any of us dares think. END

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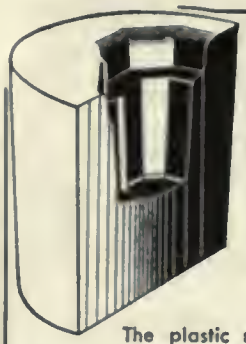

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Fabricating Industrial Tools

(*Continued from page* 48)

tleness, low impact strength, high mold shrinkage, chemical instability (which results in poor dimensional stability and warpage if not cured properly), and corrosiveness due to the acid type accelerators which will attack metal inserts and reinforcements. Their price is not prohibitive, although higher per unit volume than most plastics, but they have very little or no re-use value which adds to their cost.

3. *Hot Melt Organic Plastics*—The other class of organic plastics is the thermoplastic type which soften repeatedly upon application of heat and therefore are easily formed into shape by employing methods which push the softened plastic into conformity with the inside of a metal mold. Again, most of this class are none too fluid or stable at their melting temperatures and must be molded at lower temperatures under excessive pressure, such as is employed in the injection type of molding. More recently a subclass known as *hot melt plastics* has been developed, which permits a greater fluidity and stability at their melt temperatures so they may be transformed into shape by pouring the hot molten plastic into simple molds by a casting technique, without the need of pressure. The most successful basic plastic material for the hot melts has been *ethyl cellulose* which possesses inherent properties of toughness, high impact strength and wide compatibility with other materials for compounding.

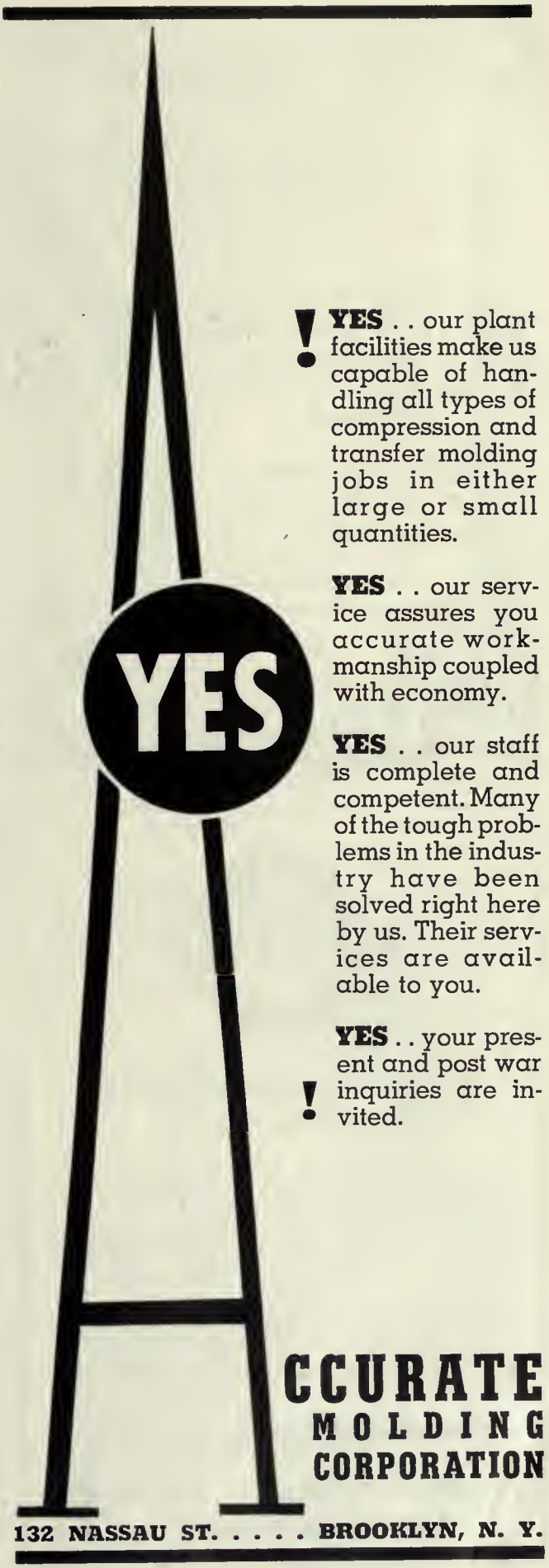
Before the war this plastic was quite new and little heard of, but with increased production and wide application in many war products where other materials failed, it promises to be one of the more useful plastics of the future. By proper compounding of ethyl cellulose with various ingredients of the plasticizer, resin and pigment type, a wide range of properties may be obtained, which makes this type of tooling plastic acceptable for a great many different tooling operations. From a drop hammer punch, where flexibility, toughness, high impact and resilience are required, to a jig or fixture, for correctly defining of any point such as the location of a drill hole or attachment part, where rigidity, dimensional stability and durability are necessary, these ethyl cellulose compositions are adaptable. They possess inherently ideal characteristics such as chemical inertness which prohibits any corrosion, complete re-use by re-melting and re-casting, low mold shrinkage and thermal expansion values, and a high degree of chemical and physical stability. Their cost on a volume basis is equal to the best of the more common metals and alloys used in the fabrication of tools. Like most materials, they too have their limitations and this is mainly their physical instability at temperatures above the normal range (150° F) and chemical instability above their melt temperatures (400° F). At low temperatures where most plastics fail because of brittleness, the ethyl cellulose plastics possesses high impact resistance even at sub-zero temperatures. This is important where plastic tools are stored out of doors and it is not possible to allow a warming up period before use.

One of the more successful plastic materials being used widely by the aircraft industry for production tools is an ethyl cellulose base plastic known to the trade as *Thermo-Cast*, developed in the chemical engineering laboratories of Columbia University, New York, after a thorough and exhaustive study of many hundred combinations of ethyl cellulose with various ingredients. It was designed in close collaboration with the tooling and plastic engineers of nearby aircraft plants and specifically compounded to meet the many requirements of the various aircraft tooling

operations. In the short while since its inception a year ago, it has satisfactorily met the many requirements placed upon it, which have included many performance tests in actual production runs, where thousands of metal parts for the airplane have been made with *Thermo-Cast* tools. In the set of physical characteristics listed in the table on page 48 may be seen the wide range of properties possible by such a blending. With a minimum of experimentation with different types of *Thermo-Cast* in any given tooling operation, one may arrive at the specific set of properties required to fully meet the demands of that job. The weight of the plastic as denoted by the value for specific gravity or volume, is approximately one-sixth that of steel, or one-tenth that of lead, which are the heavier of the more common tooling materials. Compressibility and re-set values are important to press operations where the plastic must exhibit a resiliency or spring action under tremendous pressure in order to retain its original form. The other properties indicate desirable characteristics as described earlier, which make *Thermo-Cast* exceptionally suitable for tooling. By a blending of the three grades, soft, medium and hard, a plastic of a selected set of properties may be obtained to meet the requirements of most tooling operations.

Several types of plastic tools are shown in Figs. 1, 2, 3 and 4. Included in these are drop hammer punches which have been made by using the metal die or base as the mold with the sides built up with sheet metal, metal plates, or sand. Into the top of the punch are incorporated lag bolts or screws for supporting the punch to the upper plate of the press. These are drilled and screwed into the plastic punch much the same as if it were wood. In Fig. 4 is shown one of the drop hammer presses, with *Thermo-Cast* punch and metal die located in place, ready to punch out a fuel tank cover from metal sheet. Another type of *Thermo-Cast* punch and metal die is employed for punching out the ends of a droppable fuel tank used by long-range fighter planes. Among the many types of mechanical press dies and punches, the hydroform block is perhaps the most common and widely used in the aircraft industry. Fig. 2 shows such a hydroform for making a wing rib web support for the Consolidated *Liberator*. Here the flat piece of metal sheet is placed on top of the block and the two brought in contact with a thick, very stiff rubber mat in a large hydraulic press, known as a rubber or hydroform press. Under extreme pressures of several tons of rubber pushes and bends the metal about the block to form the metal part to close dimensions. Other uses include various types of jigs and fixtures for locating the drill holes, or trim line, for the part. A *Thermo-Cast* combination drill jig and trimmer has been developed, with the metal part held securely between its two halves by the clamps. Metal bushings inserted in the plastic locate the drill properly in drilling the rivet holes, while the outer edge of the upper half serves as a scribe for marking the trim line.

Ordinary methods of precision casting are employed for transforming *Thermo-Cast* into the various types of plastic tools. Using a melter of the general design as shown in Fig. 5, with positive scraping agitator and well controlled heat source, the plastic is charged in small chunks at first and gradually melted into a fluid mass at 380 to 420° F, depending upon the grade. Maintaining uniform temperature control to prevent overheating the material, it may be melted and re-melted several times without changing its physical characteristics any appreciable extent. When sufficient melt is ready, it is poured through the bottom outlet into simple type molds prepared from almost any material, ranging from fine foundry sand and plaster of paris to wood and metal. Especially with porous type materials, because of the close mold conformity, it is usually



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necessary to pre-coat the mold with a parting compound. These, again, can be of a wide variety providing they are incompatible with the plastic. Baked enamel type varnishes or cellulose acetate lacquer for plastic or wood, and zinc stearate for metal, have been found satisfactory. For close mold dimensions, the parting film should be as thin as possible and the mold preheated to about 300-350° F before casting. Upon uniform cooling, the molten plastic sets up within a short time to a rigid, solid mass with a shrink cavity occurring on the open side or end of the mold. This shrink pocket can be taken care of in the mold design by allowing for a sprue, or machined off if sufficient thickness of the casting will permit. In other cases, the surface of the shrink cavity may be carefully warmed with a torch and filled with fresh molten plastic to avoid machining. Where extra good dimensional stability is called for, reinforcements of mesh wire, perforated metal plate or metal rods may be incorporated in the mold and the casting made in much the same fashion as reinforced concrete.

Although *Thermo-Cast* was specifically designed for aircraft tools and is being further perfected by continued development so that it may be useful in all types of tooling for post-war adoption, it has many other fields of application. Its uniqueness in possessing unusual combinations of physical properties over a wide range and its ease of molding will undoubtedly lead to many uses in the general field of plastics. With this type of plastic many articles can be readily molded at a very low cost without the need of special costly molds and expensive pressure molding equipment. A new type of low-pressure injection molding, using a heated *"grease type"* gun and simple sheet metal molds, will make the operation as easy as squeezing tooth-paste from a tube. Where this plastic has served the aircraft industry in time of war and will continue to do so in peace times to follow, it will also find a wide application in the postwar era for a great many plastic articles useful in our everyday life. END

Translucence With Barite Resins

(*Continued from page 66*)

but such is not the case. A clear solution is obtained, even in very dilute solutions, and upon the evaporation of the alcohol the original resin is obtained, unchanged. On the other hand, the cured resin may be ashed, and the white ash will be barium sulfate.

Several explanations have been proposed for the novel results. One could make the assumption that in the process, and under the conditions involved, the barium sulfate is peptized, and as a result exists in collodial solution in the resin. It seems reasonable to assume that it does not have the same role that water does in a hydrophilic resin which becomes hydrophobic, precipitating out the water in a collodial state.

This is supported by the experiment of preparing the resin with sufficient residual water to give a dense white mass upon polymerization. If such an opaque mass be then cut into a thin sheet and further dehydrated to remove substantially all of the water, the sheet will become transparent. Hence the barium sulfate must still be in the resin in its original state of collodial solution. One might go further and say that the resin and barium sulfate constitute a true solution, but certainly with the fullest kind of reservation until much further evidence is available.

The preparation of this interesting resin is not at all simple. Until exact means of controlling every step in

the process were developed, it was an exceedingly hit-or-miss affair. Meticulous care is required every step of the way. The initial condensation must be carried to a very precise point, and arrested, else a thick cold creamy resin will be obtained, impossible to pour from the reaction vessel, or a thin-bodied syrup, which a few days after hardening will be covered with thousands of fine checks ultimately growing into large fissures. Reaction temperatures must be controlled within two or three degrees, and the time within minutes. The initial condensation is controlled by means of viscosity measurements, and the final dehydration from tabulated results from numerous experiments, with initial and final viscosities plotted against moisture content. Reagents must be pure for pure white or water white cast articles, and the reactions must be carried out in glass or pure nickel reaction vessels.

Inasmuch as patents for this resin and the process for making it are pending, it is not possible to go into further details at the present time. But the description of the product and its proprieties may suggest to the reader a number of novel and useful applications. END

Cellulosics Offer Versatility

(*Continued from page* 64)

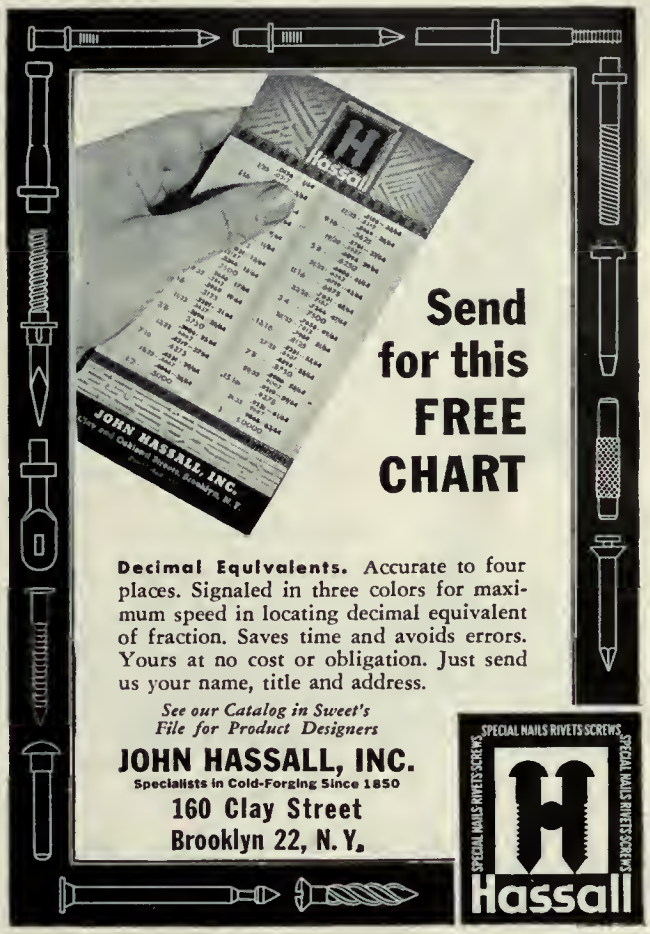
of the resins, which show so little influence of temperature.

As further evidence of the greater relative toughness of the cellulosic plastics is the fact that they practically control the whole field of film making, where toughness (or lack of brittleness) is a vital property. Again, sheet stock of the cellulosics is available in gauges down to 0.005". whereas the thermoplastic resins, because of brittleness, cannot be produced or handled economically in gauges below 40 mils.

It is not only in the preparation and handling of thin sheets that the toughness of the cellulosics is proved. In injection molding, too, this property makes possible molding with thin cross sections (sometimes supported by ribs where the area is large), and this means a saving in the amount of molding powder needed and a desirable lightness with toughness in the finished article. The preparation of plastic moldings around metal inserts again points to the toughness of cellulosics. In common with other plastics, they have a considerable coefficient of expansion and contraction, indeed far greater than that of metals. For the cellulosic plastics the coefficient of contraction is about 10 times that of the metal insert and yet even when molded in thin cross sections over large metal inserts and tested at temperatures of —70° F they remain intact around the insert. This is another example where the results culled and interpreted from field experience are the best guide we have at the moment of the performance and adaptability of plastics, and it will take some time before the knowledge accumulated through this period of mushroom growth will be adequately recorded.

Optical Qualities

A second outstanding quality of cellulosics is their unlimited colorability. In the whole field of plastics they stand alone for the range of color and the color combinations, both in random mottles and geometric design, they offer. The color possibilities run from pale and delicate pastels to bright transparents, translucent and opaque colors, and mottled and variegated effects to imitate the most beautiful products of nature, as ivory, horn, tortoise shell, marble, rare woods and mother of pearl. Of all the cellulosics, cellulose acetate has the best color base



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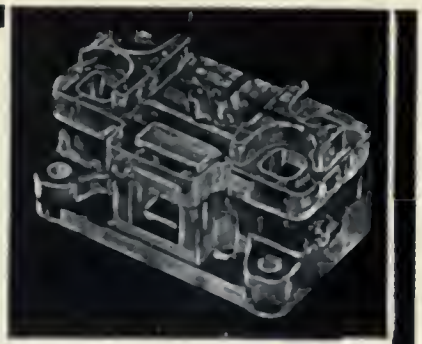

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on which to build and permits of a greater degree of conversion into clearer, lighter and more transparent colors. Actually it is second to methyl methacrylate and polystyrene for brilliant clarity, but these latter are only available in single colors, including only the range of the most delicate shades.

Since the development of ethyl cellulose has been limited by the needs of the war, its color and clarity are the least satisfactory of the cellulosics, but it is at the present time undergoing extensive color development which gives evidence of a very promising future.

Of the clarity of cellulose acetate we may say that it is of such an order that it has been approved by the Chemical Warfare Service for the fabrication of gasmask lenses. Several factors contribute to explain the pre-eminence of cellulose acetate for this optical application. Its clarity and freedom from color are critical properties, but besides these it boasts splendid moldability and a good molding job excellently done as the uniform texture and fine surface finish of the lenses insure the absence of blemishes which cause distorted vision. It also has mechanical strength and lack of brittleness unequalled by any other plastic suitable for this application. The moisture sensitivity of the cellulose acetate lens material, which is a property of this and other cellulosic plastics, is readily and easily compensated for by the design, so that the lens fits accurately into the socket.

In optical properties, the cellulosics share with the acrylics resins and polystyrene the clarity and freedom from color needed for plastics destined for use in optical applications. The refractive index of cellulose acetate and methyl methacrylate is identical, and the percentage of light transmission of all three plastics is similar; indeed their degree of clarity is similar, especially in thin sections. However, in thicker sections of colorless transparent cellulose acetate, a slight turbidity or haze can be seen which causes a scattering of some of the light in its passage through the plastic, thus reducing its clarity.

This phenomenon is not inherent in transparent cellulose acetate, as is proved by the fact that we are able to prepare readily in the laboratory beautiful samples in heavy sections of crystal clear cellulose acetate possessing the maximum brilliance exhibited by any plastic. This presages a time when, with improved manufacturing facilities, the cellulose acetate destined for optical applications will be of the same superlative quality of the laboratory samples.

The complete range of single colors may be readily imparted by adding pigment or dye during the processing of the molding powder. Random mottles may be made either by injection molding or by rolling the two colored lots together in a double layer. Random mottles with a certain depth in the design result from this process. Geometric designs are only possible by the block process. This consists of preparing blocks of plastic under heat and pressure. When cooled, the blocks are cut into sheets of varying thickness, according to the requirements of the ultimate design. The sheets of varying colors and thicknesses are placed in a pile and are formed into a block again under heat and pressure. This is then cut vertically, diagonally or otherwise, again blocked and re-cut till the final pattern results in the block which is then finally sheeted, each sheet carrying the color and pattern created. The thin gauge sheets which were cut to make up part of these intricate patterns and designs again emphasize the toughness of the cellulosics to the extensive handling demanded by the block process.

The sheets then prepared may be further fabricated into tubes by shaping on a mandrel and the edges cemented, care being taken to match the design. In this way tubes

(which are usually associated with extrusion and injection molding) may be formed with a precision of design characteristic of fountain pen barrels, and with a variety and beauty made possible only with the cellulosic plastics sheeted by the block process.

Dimensional Stability

A third property of plastics which has far reaching effects is moisture sensitivity. All plastics absorb moisture to some degree, although the amount of water absorption of the thermoplastic resins is practically negligible. From a study of the amount of moisture absorbed by representative plastics (Fig. 3) during a standard ASTM test, it will be seen that the cellulosics do absorb some moisture, a property which has to be reckoned with in considering applications for cellulosic molding powders. The fact that the cellulosics (or other plastics) take up a small amount of moisture is in itself of no more practical significance than that one's warm and comfortable topcoat contains a certain percentage of moisture.

There are innumerable examples of plastic parts performing excellently in service and "as good as the day they were made," despite the property of moisture absorption. This property becomes of importance only when it causes dimensional changes, or changes in form of the molded part. This change may be one of expansion and contraction in the plastic without noticeable warpage. Experiments have determined the percentage of moisture absorption at equilibrium in a typical cellulose acetate and ethyl cellulose formula in an atmosphere of 90% R.H. (Fig. 2), and the percentage of linear expansion resulting in the molded bars of both materials. The expansion in the cellulose acetate is less than 1% (corresponding to about one-fourth of the water absorption) and that of the ethyl cellulose is less than 0.5%, (correspinding to about one-seventh of the water absorption). This resistance to dimensional change is one of the outstanding qualities of ethyl cellulose. In small objects it will be seen that humidity expansion is very small. In the case of objects such as name plates, any possible distortion due to humidity expansion and contraction may be compensated for merely by making over-sized screw holes in the plastic.

In large, flat sections, as obtained in sheet stock for use in the aircraft industry, very precise allowances for humidity and temperature expansion and contraction are made in fabricating the parts. But dimensional changes may also take the form of warpage—which is a more complex phenomenon, partly physical and partly chemical, resulting from the release of stresses created in molding. *Warpage may or may not be caused by moisture.* During molding, all plastics are heated and made to flow under the influence of temperature and pressure. Stresses are set up in the plastic, and as this is chilled these stresses remain imprisoned in the material. If the molded piece is not placed under an excess of heat or humidity the stresses remain dormant in it and no deformation or warpage will result in the finished part in service.

Physically, warpage may be explained as the slippage of the molecules over each other—"to settle" into a less strained position. The presence of a plasticizer in the cellulosics assists the slippage of the long chain molecules over each other when warpage occurs. Since the plasticizer is a vital factor, behaving somewhat as a lubricant assisting warpage, those hard formulations containing less plasticizer will also have less tendency to warp when exposed to excessive heat and humidity. In other words, *it is the harder, less plasticized formulations which offer the greatest dimensional stability.* For cellulosic esters of equal flow, a cellulose acetate molding powder contains

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more plasticizer than a cellulose acetate butyrate compound, and experience in the field confirms that on plastic parts of equal flow, the tendency to warp is greater in the former. Therefore, to obtain the same resistance to warpage in both molding powders, it is necessary to take a less plasticized cellulose acetate formulation, that is, one of harder flow. Again experience in the field has shown that a cellulose acetate formulation of H_4 flow has the same resistance to warpage as a cellulose acetate butyrate of H_2 flow.

Both the chemical structure and the low plasticizer content of the ether, ethyl cellulose, impart to it an exceptional dimensional stability, or resistance to warpage. This is dramatically proven by comparison of flares of all three cellulosics after being subjected to the same accelerated aging test.

It has been said that moisture may or may not cause warpage. It is probable that the prescence of moisture acts as a plasticizer aiding and promoting the release of strains that result in warpage. But it is precisely those hard, less plasticized formulations which resist warpage so well that have the greatest water absorption, indicating that *warpage is related to total plasticizer content rather than to moisture absorption.* On the other hand, if a plastic part is heated above what might be called its service temperature, the strains are released and the molded piece warps. Thus is explained the warpage of a practically non-hygroscopic material such as polystyrene.

From the foregoing it is clear that warpage must be tackled rather as a problem of molding than as an effect of moisture absorption. If it were possible to control the flow of a plastic into the mold so that it could cool in a "strain-free" way, then warpage would be eliminated. In practice it is known that even a mechanical detail like the method of gating a die can produce very marked effects on the warpage characteristics and tendencies of the resulting part.

Future of Cellulosics

Consumers continue to manifest a tremendous interest in the products that will be available to them in the post war period and for these consumers cellulosic plastics offer much. In the home, from cellar to attic, parts and pieces will exploit these plastics thoroughly for the brilliant color variety which marks them for the light weight homemakers look for, the ease of maintenance which housekeepers demand, and the economy which mass production of plastics makes possible. Outside, cellulosic plastics will be in evidence everywhere in the stores where they will be used again, decoratively and functionally, to merchandise packages of peas or porridge. Cars, planes, heavy industry, the field of electronics,—all these and many others will bring the consumer face to face with cellulosic plastics in the post war years to come. END

Saran Tubing At Work . . .

(*Continued from page* 21)

by the factor of "suitability"—and relative ease of installation and the ability to withstand the hazards of the use for which it is intended.

There are certain things which thermoplastic pipe does not pretend to do. It does not, for example, claim either the rigidity nor the bursting strength of iron or copper. Nor does it pretend to withstand the temperature extremes of the metallic products.

On the other hand, Saran pipe does claim sufficient rigidity, bursting strength and resistance to temperature

extremes to make it adaptable under a broad range of conditions. It further claims far greater chemical resistance than any commonly used metallic material, in fact is believed to be resistant to more chemical substances than any other plastic. And to complete the picture it is an excellent electrical insulator and is, on the whole, easier to work with and install than metallic piping materials by virtue of its light weight and machinability.

Saran tubing possesses the same chemical and electrical characteristics as Saran pipe, is far more flexible than any metallic tubing and has the added advantage of translucency. Saran fittings for both pipe and tubing, injection molded in all standard sizes, embody all the basic advantage of the material.

Here are two "case studies" of these thermoplastic materials in action, not because they are glamorous, but because they are doing a better job than any metallic material could hope to do in these particular circumstances. They are typical of sound "replacements" embodying improved performance, long-term cost economies, or both.

Case No. 1

A part of the waste disposal system of a large chemical company embodied a pump which had the function of moving certain highly corrosive acid wastes from one location to another. A section of iron pipe on the discharge side of this pump was customarily replaced every two to three months because of complete failure due to the corrosive action of the acids. In March 1943 this pipe was replaced with a section of 4" Saran pipe. Up to the present time this piece of pipe has functioned perfectly. It has thus already equalled the life span of four to six new sections of iron pipe and saved the labor costs that would have been involved in installing them. Since it does not yet show any damage whatsoever from the corrosive fluids its life expectancy is indefinite.

Case No. 2

The sinks of a large chemical laboratory located on the second floor of a building were drained by pipes running across the ceilings of rooms below and converging into vertical stacks leading to the basement where they connected to the disposal system.

These drain lines were constructed of special vitrified (ceramic) tile. While the tile itself proved satisfactory it was difficult to install correctly and the joints, which were necessarily of cemented construction, constantly developed leaks. Some new joints showed leakage in as little as two weeks. Since the first floor of the building was occupied by offices and additional laboratories, the dripping of acids, caustics and other chemical fluids from these joints represented a continuous annoyance and hazard.

About July 1943 the company began replacing the ceramic drain lines with 2" Saran pipe, and the project was carried on over a period of several months, as dictated by failure of the joints of the tile lines. Earliest Saran installations were of welded construction, as fittings for the larger sizes of Saran pipe were not then available. Later erections were made with standard 2" Saran fittings.

Erection crews found that the Saran pipe went up rapidly and easily. No leaks have developed in either welded joints or fittings and the entire system is proving highly satisfactory. This again is a replacement which has licked a costly maintenance problem and eliminated a potential hazard.

It should be evident, of course, that laboratory sink drains such as these are subjected to every type of punishment in the way of acids, caustics, solvents and other destructive substances.

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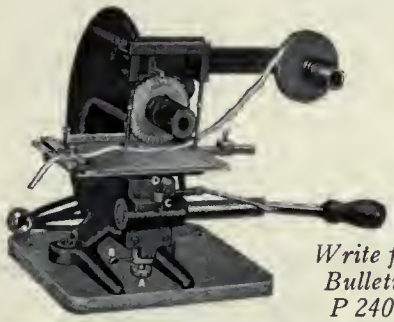

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Case No. 3

This case also involves chemical resistance, but from a different angle than the two preceding cases. In connection with the same laboratory an ion-exchange water purification unit is operated to supply the equivalent of distilled water for use in laboratory work. Although regeneration of the system involves the use of approximately 10% strength hydrochloric acid which is carried through Saran pipe and tubing, the chief concern is in avoiding contamination of the purified water from corrosion inside the discharge lines.

Iron pipe, and to a lesser extent copper pipe, corroded in a comparatively short time. The purified water then picked up this rust or corrosion from the inner walls of the discharge lines and reached the laboratory unfit for analytical work.

The installation of Saran pipe and tubing throughout the discharge end of the system has completely eliminated the problem since this material does not rust, corrode or scale. For the same reason the tanks of the purification unit are also lined with Saran.

Case No. 4

In an experimental or "pilot plant" air pressure, from various pieces of equipment, is carried to a bank of recording instruments by means of flexible tubing. Copper tubing was used for this purpose until the war came.

As a substitute, Saran tubing was brought into use and has now replaced the copper entirely. It was found that the Saran not only functioned with equal efficiency but had several advantages making it more desirable than copper.

Since experimental processes are involved the pressure tubes are undergoing constant changes to accomodate various equipment units and instruments. The extreme flexibility and light leight of the Saran tubing make it exceptionally easy to handle and men working in the instrument room quickly learned to make complex connections. Armed only with a pocket knife, a simple flaring device and an assortment of fittings the men are able to make new connections almost in a matter of seconds. Since the plastic fittings are slightly resilient, couplings may be made leak-tight by hand pressure only, without the need for wrenches.

Translucency of the tubing is also found to be an advantage here as any slugs of liquid which may get into the pressure lines can be readily detected.

So perfectly does Saran tubing seem adapted to this application that the superintendent in charge of the unit states he would not consider reverting to metallic tubing even if it were readily available.

Case No. 5

A plant having a rectification station for the purpose of converting 13,800 volts of alternating current to 600 volts of direct current made an installation of about 4,000 feet of Saran pipe and fittings in the heat exchange system.

In the process of rectification, power losses occur in the form of heat. This heat is absorbed by water jackets on each of the several rectifier units and is carried by means of a closed-circuit water circulating system to heat exchangers where the heat is finally carried away by river water. The excellent electrical insulating properties of Saran pipe recommended it for the purpose of carrying the water from rectifiers to heat exchangers, thus preventing grounding of the 600 volt potential in the rectifier water jacket through to the river water piping system. The water flows to the heat exchangers at 140 to 160° F. and returns to the rectifiers at approximately 85°.

Saran's corrosion resistance is an added factor in this case, preventing scaling or fouling in the rectifier jackets. This installation has been in more than a year and the life expectancy of the Saran far exceeds that of rubber pipe which was previously used for such applications. END

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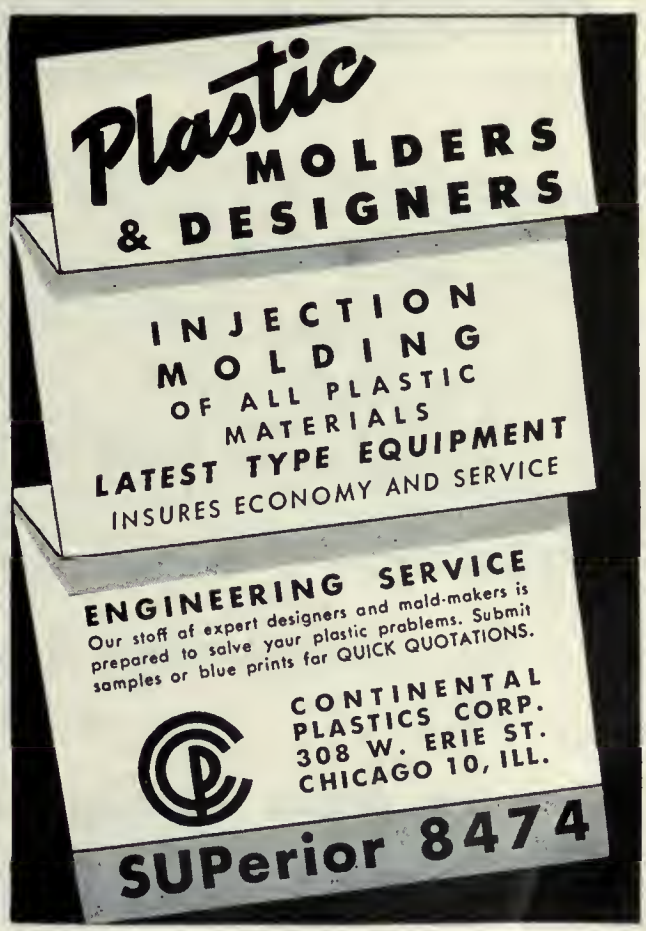

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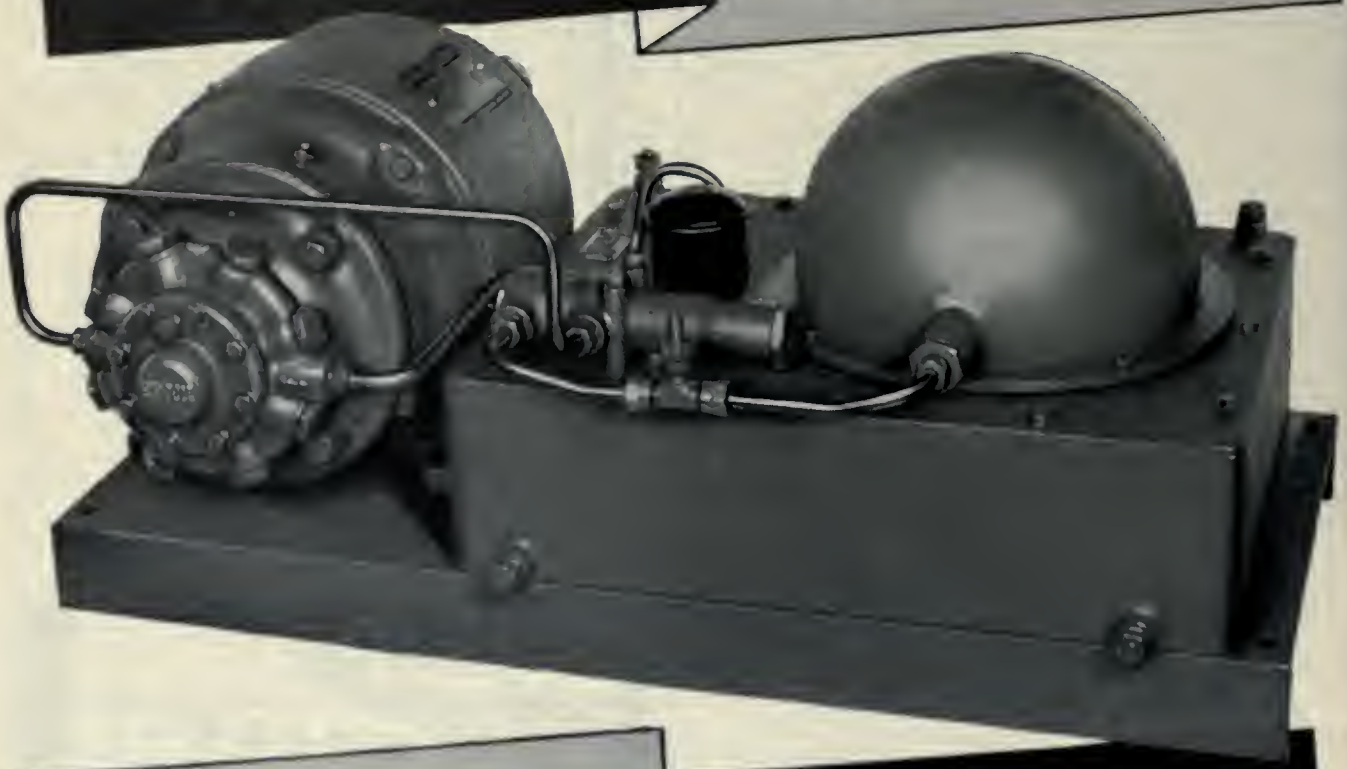

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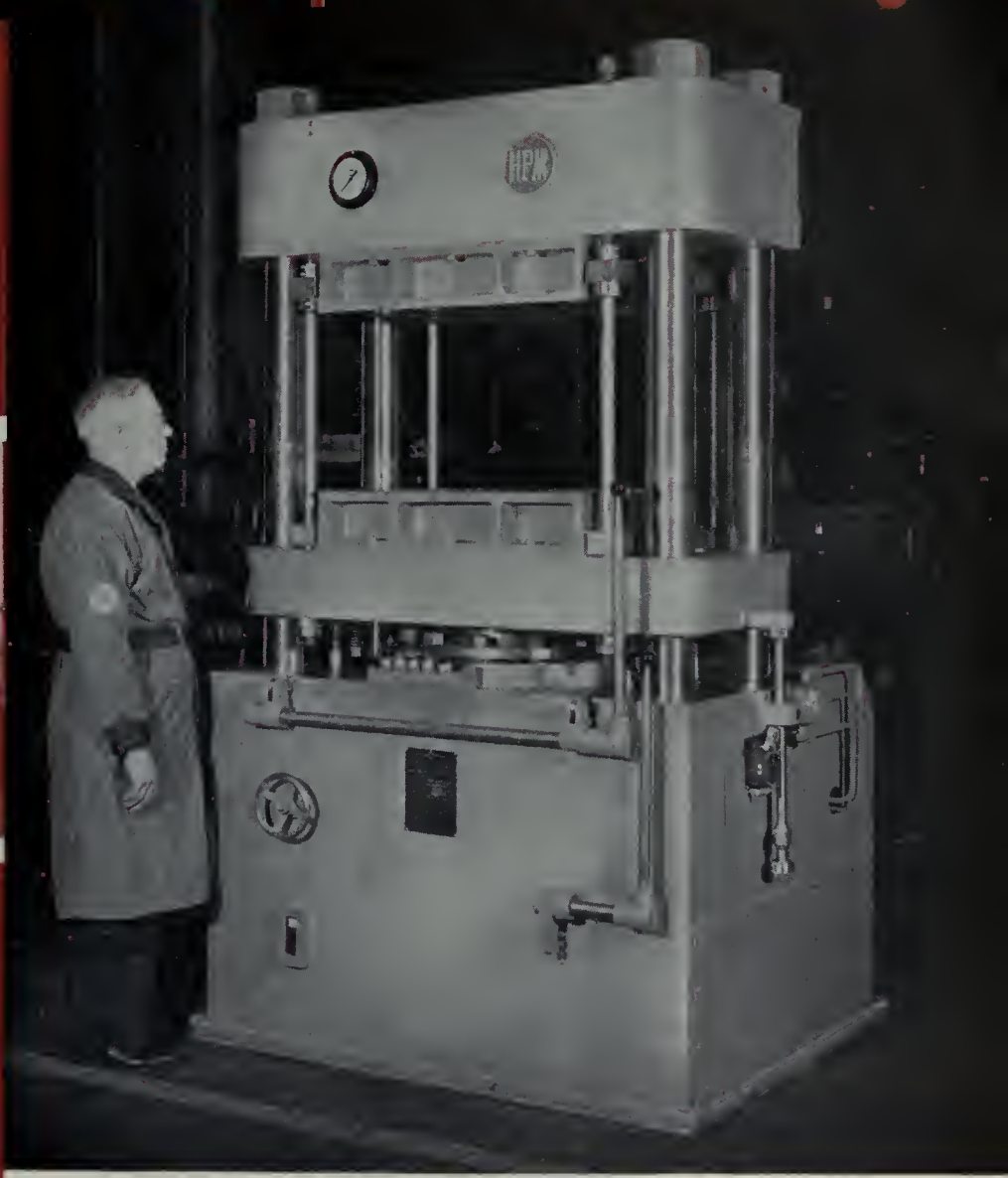

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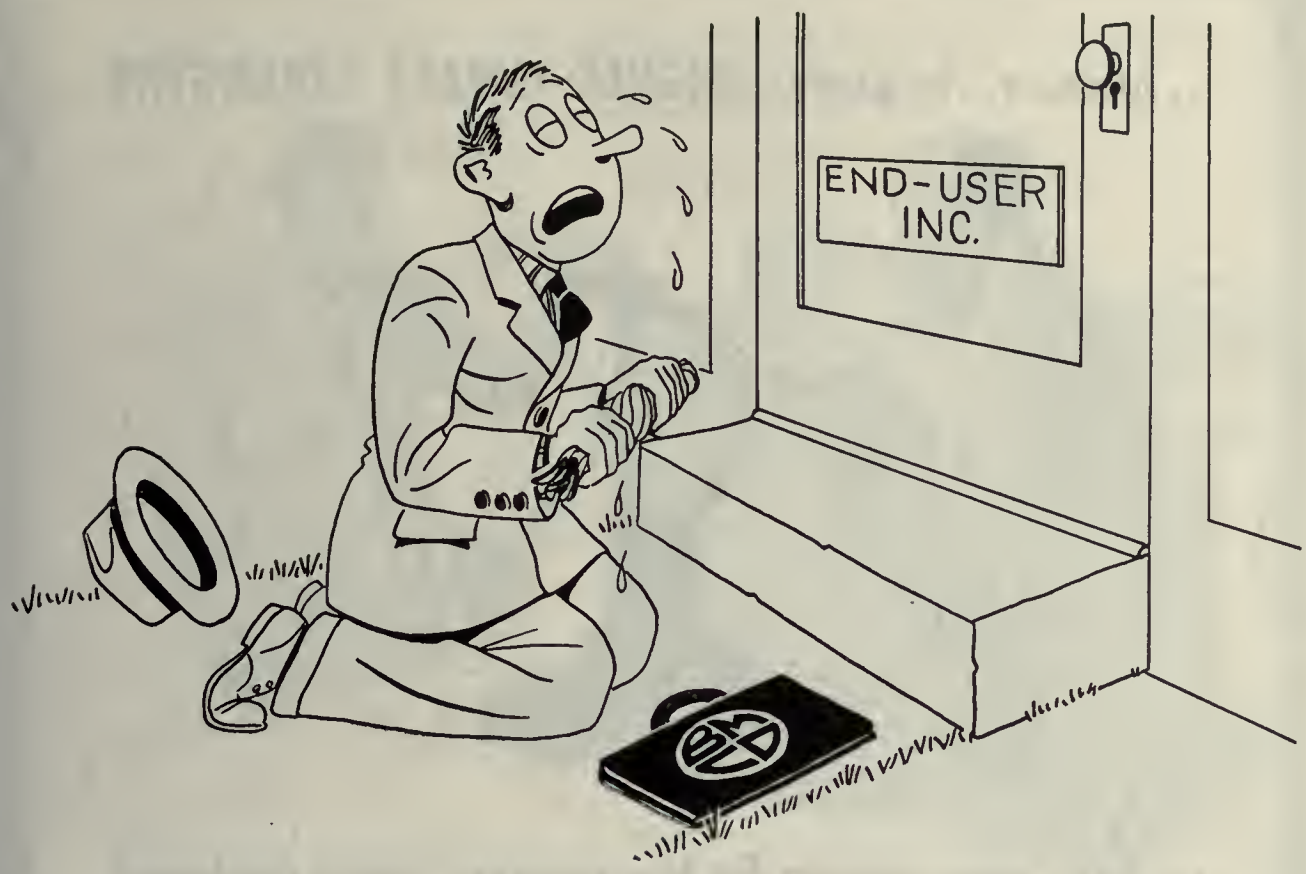

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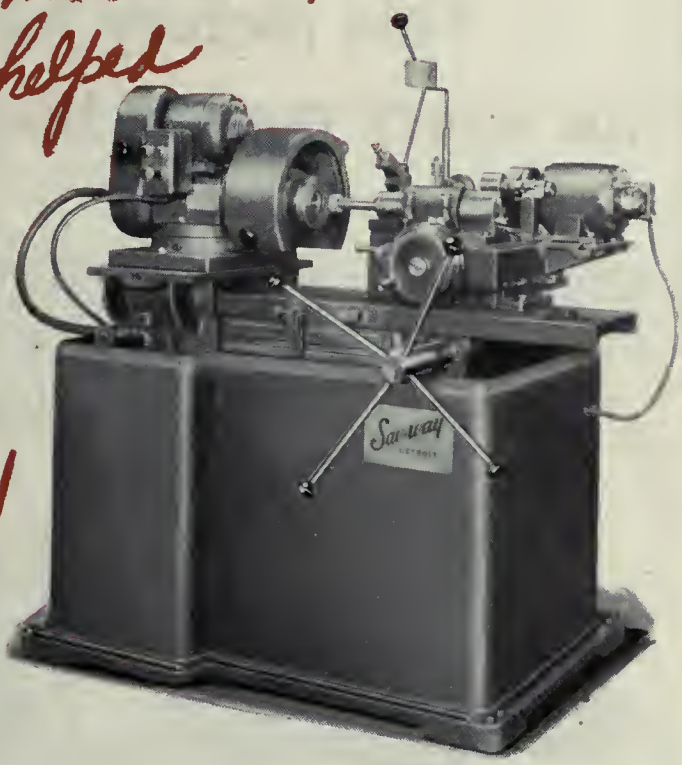

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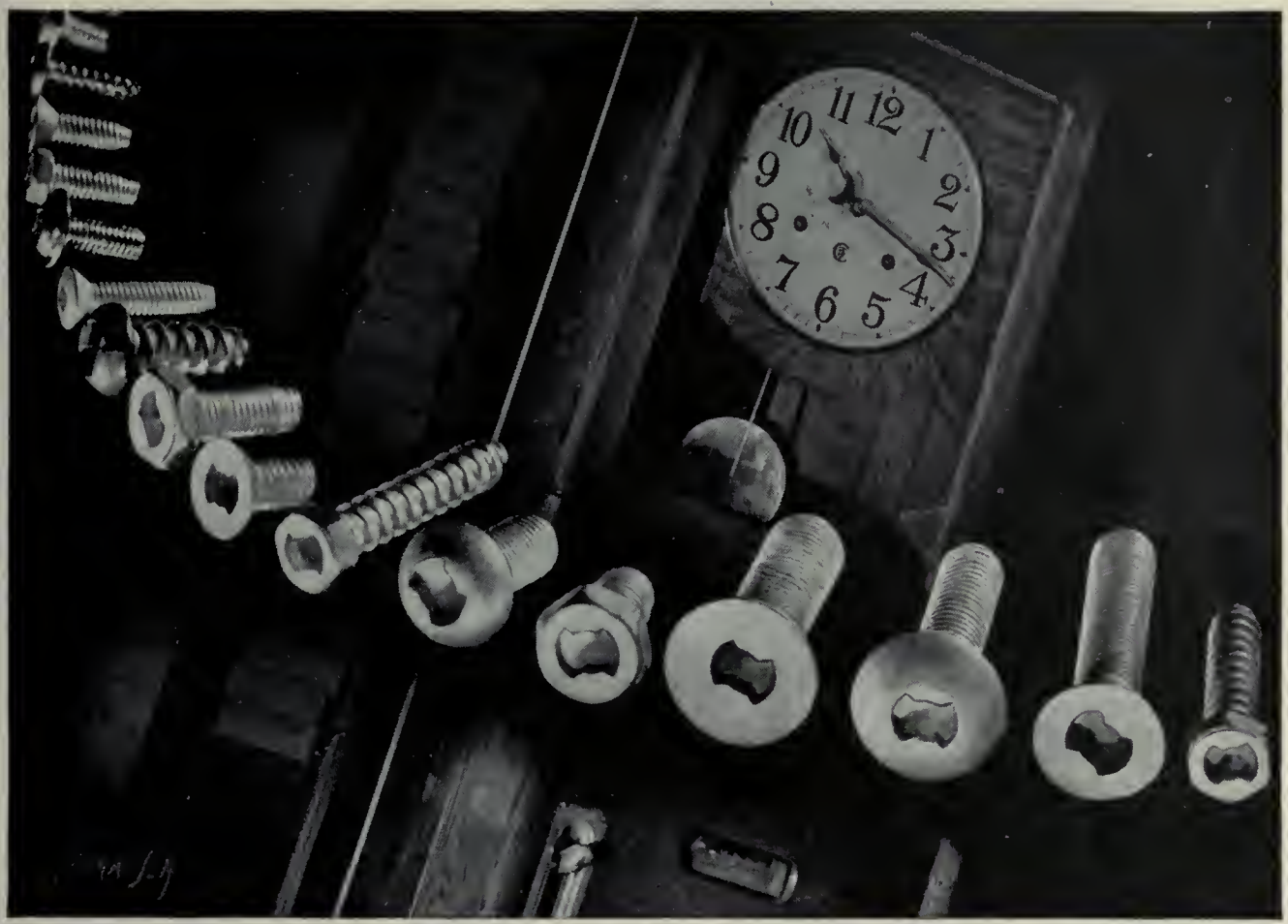

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PLASTICS in PERSPECTIVE

PEOPLE who talk about the Plastics Age succeeding the Steel Age as the Bronze Age followed the Stone Age and was itself followed by the Iron—and Steel—Age, forget one important thing—that it was not a case of one material superseding another, for obviously we still make abundant use of stone and bronze. For that matter we also use a great deal of another material—wood—which somehow was never dignified by having an "Age" named after it. And that is a clue to the real point of the matter. The various Ages were so called (by later times) because they introduced new and revolutionary tools, made of the material from which the era received its name. The Bronze and the Steel Age brought new tools. Wood was and is largely a *material;* so are plastics. If they attain the extensive use of the products of the forest, the industry won't be much concerned whether this is a Plastics Age or just a mighty good time to do business.

* * *

Plastics products gave a good account of themselves at the Housewares Show held recently in New York. That they did so may be largely attributed to the fact that they spoke for themselves, for plainly the salesmen, whose business is talking, were tongue-tied when it came to plastics.

This does not refer to the men who handled purely plastics items, but to those who were selling composite products of which various plastics were components. If you asked them what kind of plastics their goods contained, some of them just didn't know what you were talking about and could only repeat, helplessly, "Plastics." Some salesmen repeated the word in an angry tone, as if to make out that you were the ignoramus: everybody knows that plastics are plastics. But a few were decently embarrassed, as if they caught on that maybe there was more than one kind.

The products in question were consumer goods. It is not likely that among engineers and designers the ignorance of plastics is still so dense. But it is serious enough that the intermediaries who sell goods to store buyers and merchandise men should know so little about them.

It is time that the industry inaugurated an educational campaign along the lines suggested by George K. Scribner, president of the Society of the Plastics Industry at its conference last May. At that time Mr. Scribner pointed out that such a campaign had to be simple. First, the people ought to be told that there are different kinds of plastics just as there are different kinds of metals. Secondly, they should be given specific names, simplified from the actual chemical names, for each type. Thus, cellulose acetates could be called simply acetates, cellulose acetate butyrate butyrates, and so on. It is true that when you get to such resins as polyvinyl chloride or polyethylene, it is difficult to extract an obvious abbreviation.

In these cases, why not invent the equivalent of trade names such as Saran or Lucite? Such invented names would of course have to meet with the general approval of the industry. But the task, under SPI auspices, ought not to be formidable. Any name would be better for a plastics type than the generic name, plastics itself, as used by our houseware salesmen friends.

•

HISTORY has a peculiar way of repeating itself: And, all things considered, it should do so again after this war. Which brings to mind the tremendous possibilities which will be opened to the industry when production, design and research can turn to peacetime rather than wartime pursuits.

Undoubtedly, development spurred by urgent war needs, has advanced the industry far beyond what its normal progress would have been. The public is due for a number of very pleasant surprises when, as the need for secrecy disappears, it learns about these developments. Even greater surprises are in store for them when these developments become available commercially.

The war cannot last forever, and there are real signs today that the end is not too far off. The progressive company is looking ahead, and is already scouting its markets, endeavoring to learn where the demand is, sounding out the likes and dislikes of its customers. Armed with such facts, a company by intelligent planning will, within a reasonable time after the war, be ready to enter the commercial field with a host of products for which there is an immediate and abundant demand.

Plastics have earned an honored place for their achievements in war. Post-war, they will continue to hold that place in industry by taking advantage of experience stored up under the stress of war, and then suddenly unloosened on a product-starved market intent on getting modern and eye-appealing merchandise of durability and utility. This is when plastics will have their day, provided, of course, the whole planning has been wise and judicious.

•

IF anybody ever thought seriously that there was going to be a battle royal between the metals and plastics industries for the post-war market, he's likely to be greatly disappointed. As a matter of fact, there probably never was any reason to feel that the two industries would do anything but complement each other, rather than engage in a knock-down, drag out competitive struggle.

The idea that these products are always competitive arose naturally from the fact that plastics materials were substituted for metals when the latter were on the critical list. It is conceded that many of these substitutions will be permanent, and to that extent, plastics are a direct competitor of metals.

But there is still a large field in which both types of material can be used together advantageously. The article in this issue by Arthur Biddle of the Reynolds Metals Company develops the point. The very fact that a firm which has made history in metals and could rest on that record alone, has found it imperative to carry out researches in plastics materials and has obtained important practical results by combining the two, is most significant. The actual work they have done should stimulate fabricators of other products to keep the same possibility in mind. END

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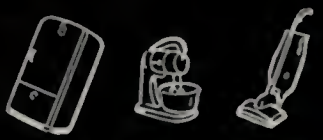
FOR ELECTRICAL APPLIANCES 

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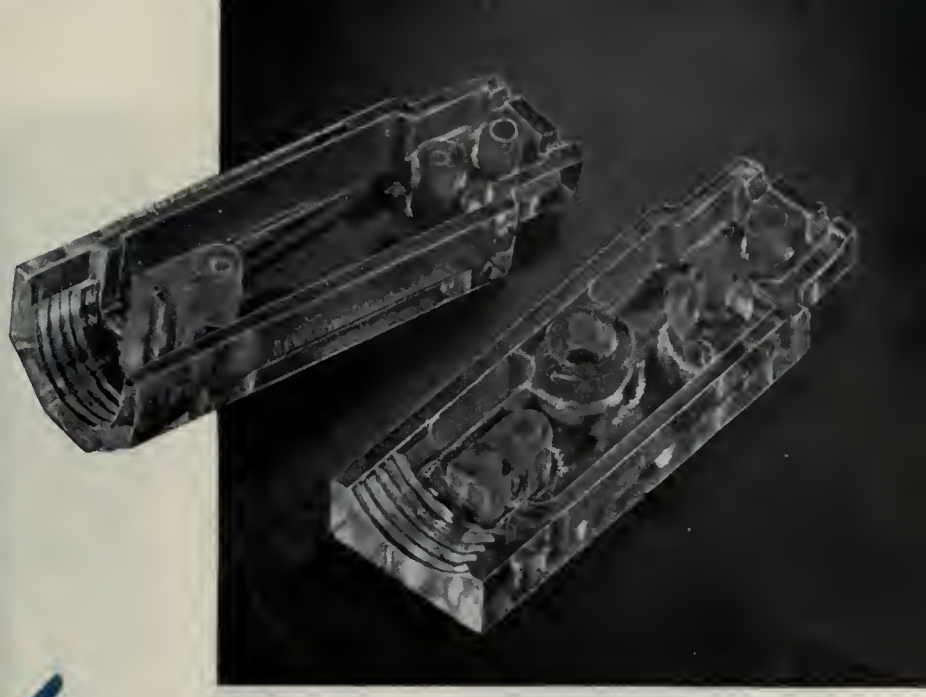


Fig. 1. This transparent acrylic pre-mold model is an exact replica of the electrical connector study model made of "Tenite" shown in the photo below

Models Before Molds

New Technique Permits Foresight Into Varied Production Problems

By Carl Stricker
Stricker & Brunhuber

ERRORS in molds, causing great expense and time-waste, have been effectively eliminated by making plastic models in advance. Such models, costing only a fraction of the mold, may be considerably less than the alteration expense necessitated by a blue-print error. Actually, this cost-and-time saving feature forms only one of the purposes for which manufacturers, distributors and others require models to be made.

In general, from a standpoint of function, there are three types of models. They are all produced in the same way, but the purpose of each is different. They are: (1) The study or demonstrator model (Fig. 1—bottom), (2) the development or experimental model and (3) the pre-mold model (Fig. 1—top).

Almost any plastic material serves for model-making—*Lucite, Plexiglas, Lumarith, Tenite, Catalin* among others. By far the greatest tendency is toward transparency in the materials of which models are made and, considering the uses to which models are usually put, this tendency is a natural one.

Study Models

The first model type, the study model, is used most often to provide direct visibility of the form, use, or operation of a device or part, especially of internal construction and operation. These models have played their strongest role as sales-promoting units and training devices. The Ford Motor Co., as one instance, has greatly improved employee-training technique and has cut down training time, through the use of acrylic plastic models at its Willow Run plant.

Fig. 2. Model of demonstrator wringer: most parts of "Tenite"

Fig. 4. Milling work on "Plexiglas" model for a post-war item

Fig. 3. Plastic study model of Standard Oil lubricating unit

The old-style cut-away and sectional metal models and blue-prints used in the teaching of the function and operation of intricate bomber parts have been largely eliminated through the use of transparent plastic models. Trainees, instead of being *told* how the part works, now *see* it work.

Plastic models in sales promotion work not only eliminate a good part of the customary printed material and oral effort, but offer an approach to the dissipation of sales resistance that has a dramatic and realistic quality. As in the case of the trainee, the prospective customer need not be *told* that the unit works; he *sees* how it works (Fig. 2).

The study or demonstrator model may be merely a housing for a unit under demonstration, an integral part of the unit, or the entire unit.

A plastic model used as a housing for an electro-mechanical device is shown in Fig. 7, in comparison with the normal metal housing. The purpose of the transparent plastic housing in making the internal operation visible is obvious. What is not so immediately apparent is the fact that the model, since it is made of plastic material instead of heavy metal, greatly reduces the overall weight of the unit and consequently makes it far more portable. This is no small consideration when a demonstration unit is to travel extensively and to be shown frequently. Due to this weight reduction factor it is possible to display more of the unit.

A "Lucite"-metal shock-absorber is an example of a study model with plastic parts integrated with the metal parts that are normally characteristic of the unit. Here, when the device is in operation, the plastic parts are in mechanical interplay with the metal ones. Where plastic elements are to mesh with original metal ones, the meeting of tolerance requirements in the making of the model is

Fig. 5. Hand-finishing a laboratory instrument housing model

clearly an important consideration for the fabricator.

There are interesting possibilities in this integration of plastic and metal parts in a single unit in the matter of contrast alone. It is often desirable to concentrate the observer's attention on a single element in the device; either because that element is the key feature or because it represents a new departure and an important sales point. If this element is of metal, as normally it would be, and if the surrounding parts are of transparent plastic, the metal part, by contrast, stands out to the eye alone. Even where the demonstration unit is entirely of plastic material, there are possibilities, still largely unexplored, of using contrasting plastics, transparent against opaque, and transparent against color, to focus attention to the desired part.

A highly effective utilization of color contrasts for differentiation of parts is a characteristic of the all-plastic model of a lubrication unit in Fig. 3. The housing is of clear transparent plastic; the individual internal parts are of clear plastic of different colors. This variation of color serves not only to differentiate the functions of the parts, but also to fix each part individually in the memory.

There is a wide range of functions, as well as possibilities, in the second type, the development or experimental model. It provides, (1) A concrete basis for development of an idea or the completion of a partial conception, (2) a basis for refinement of design or redesign, (3) a unit for testing in use and operation, (4) a means for spotting and eliminating "bugs", (5) a guide for more accurate judgment of workability, of ultimate costs and of more efficient molding practice, (6) a unit for testing sales appeal, (7) a basis for close comparison with similar items on the market.

As an example, and one that occurs with increasing frequency, there is the conversion of a manufactured item from metal to plastics. Will the item function as well in plastic form as in metal, or will it function better? Will the plastic item retain the rigidity or flexibility of the metal item? What is the comparative durability? Can the desirable characteristics of the item in metal be retained, compensated for, or even enhanced in plastic form? While these questions can be partially answered on paper, the complete answer is in an accurate plastic model for, to all intents and purposes, the model is the ultimate item itself. Suppose the model reveals that the item, as originally conceived, will not do what it was designed to do. That revelation alone will forestall a good deal of subsequent expense. It will do more, it will show whether and how a redesign of the projected product can be developed.

In the matter of budgeting costs in manufacturing plastic items lies another example of the function of the development type of model. *Calculations* may, for instance, show 12 oz per piece as the ultimate weight of the plastic material involved in the molded item. An *actual model*, on the other hand, will show 14 oz of plastic material per piece. Here is a single factor which, in large-quantity production, is enough to destroy all cost calculations.

While all plastic models must be made accurately to specifications, especially those that are to be tested in actual operation, the greatest possible degree of accuracy must be maintained in making the third type, which is known as the pre-mold model. The pre-mold model anticipates trouble, is made for just that purpose. Since it is a three-dimensional, seeable, measurable and exact specimen of what the molded item will be, it provides a positive check against the blue-prints before the specifications are committed to a mold. An error in the drawings will be caught in the model and will not be transmitted to the mold. Where close tolerances are a factor in the design, this error-anticipation by the model is especially important.

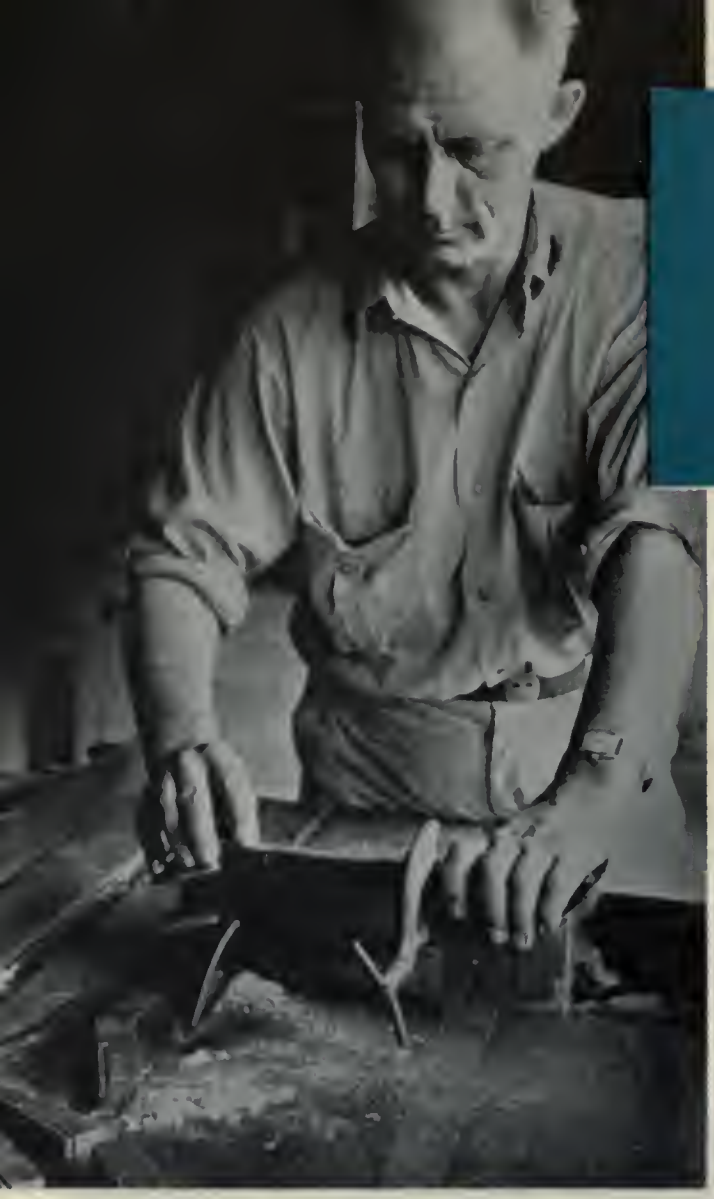
How extensive a single error in the blue-print can become is apparent when one considers a multiple-cavitied mold for large production runs. In a mold consisting, for example, of six cavities, the single blue-print error is repeated six times. The greater the number of cavities, the greater the number of blue-print-generated errors in the mold and the more difficult and expensive the revision.

There are a number of reasons for the great difference in cost between a model and a mold. Cost in both cases de-

(*Continued on page 89*)

Fig. 6. Micrometric measurement, a vital step in model making

MACHINING LAMINATES



Smooth sawing of laminated plastic materials requires that careful attention be paid to size and set of saws

Where close tolerances are not demanded by the work, band sawing, a comparatively simple job, is adequate

A Discussion of Machines and Techniques Required in Producing Laminate Parts

By L. T. McCloskey

Vice-President, Taylor Fibre Co.

FABRICATING laminated plastics requires a considerable investment in shop equipment and machine tools. It also involves problems of labor, production, inspection, rejections and scrap-disposal. For this reason, many users of fabricated parts made of laminated plastics prefer to entrust the fabricating problems to the manufacturers of the plastics.

However, since there are still some manufacturers who prefer to do their own fabricating, it is felt that a thorough discussion of the various processes by which laminated plastics may be fabricated will be helpful in enabling them to obtain the best possible results.

How to Machine Plastics

This article is the first in a series to be published in *plastics* describing in detail proper procedures to follow in machining various plastic materials without using special equipment. Acrylics will be discussed in the next issue.

Smooth Sawing

Vulcanized fibre and phenol fiber can be sawed to a smooth edge and close tolerances if the proper saws are used and the proper specifications are followed. The first requirement is a good-grade metal-cutting saw, hollow ground with no set to the teeth and with a hook of from 0° to about 10°. The saw teeth should be square, sharp and free from burrs and wire edges. Burrs and wire edges may be removed from the side of the saw, after sharpening, with an abrasive block. There should be 5 points per inch for stock up to ⅜", 3 points per inch for stock over ⅜", and 8 points per inch for tubing. Width should be 13 gage (0.095") for stock up to ⅜", and 10 gage (0.134") for stock over ⅜". Three different diameters are needed. For 1/16" stock, use 12" diameter. For stock from ⅛" to ½" use 14" diameter. For stock over ½" and for tubing, a 16" diameter is best. The saw should be operated at from 2500 to 3600 rpm, the higher speed being preferable. Feed the work for free cutting, but do not force it. When cutting tubing, a better edge and less heat-

ing will result if the tube is slowly revolved. For production sawing, the saw should be hardened and permit sharpening by grinding only. The rim of the saw should be concentric with the center hole. It is very important to keep saws sharp. Dull saws cause chipping and excessive heating.

Band Sawing

Vulcanized fibre and phenol fibre can be band-sawed if smooth edges and close tolerances are not required. Band saws should be tempered to permit filing. The teeth should be alternately staggered to give clearance and eliminate heating. Their set should vary from 1/3 to 1/2 the thickness of the saw. For straight cuts, use a medium set; for circular cuts, use a heavy set. The smaller the circle, the heavier the set should be. When in constant use, saws should be re-set at least once a day. For best

Slotting phenol fibre on a hand milling machine. Milling requires high-speed steel or sintered carbides

results, use saws with 5½ points per inch and a thickness of 20 gage (0.037″). Widths may vary from ¼″ for scroll work to 1½″ for heavy sheet sawing. The saw should be run at from 4000 to 5000 fpm. One should feed it at a rate for free cutting, but be careful not to force it. Saws may be sharpened by filing or grinding straight across the tooth in automatic sharpeners.

Threading

This process requires high-speed steel chasers with a slight negative rake. The chasers should be run at about 60 fpm and fed at from 0.007″ to 0.010″ deep, lessening as the cut deepens, and allowing 0.003″ cut to finish. All burrs should be filed off between successive cuts. For fine threads, best results can be obtained by chasing on an engine lathe. For strong, clean-cut threads it is essential that chasers be kept sharp. For quantity production, use self-opening dies.

Tapping

When tapping laminated plastics, one may use the same type tap used for metal, preferably of high-speed steel. The tap drill should be from 0.002″ to 0.005″ larger than for metal, however, to prevent the tap from breaking and to provide a good thread. A speed of about 60 fpm is best. For holes bigger than 1¼″ or 1½″, it is best to use collapsible taps. These will enable one to step up production and still give very satisfactory results. A slight chamfer around the edge of the hole will prevent uplift. If it is necessary to tap parallel to the grain, the product should be supported by a clamp, during the tapping. If the tapped hole runs small, dubbing back the cutting edges for about the first ¼″ of the tap will tend to produce a larger tapped hole.

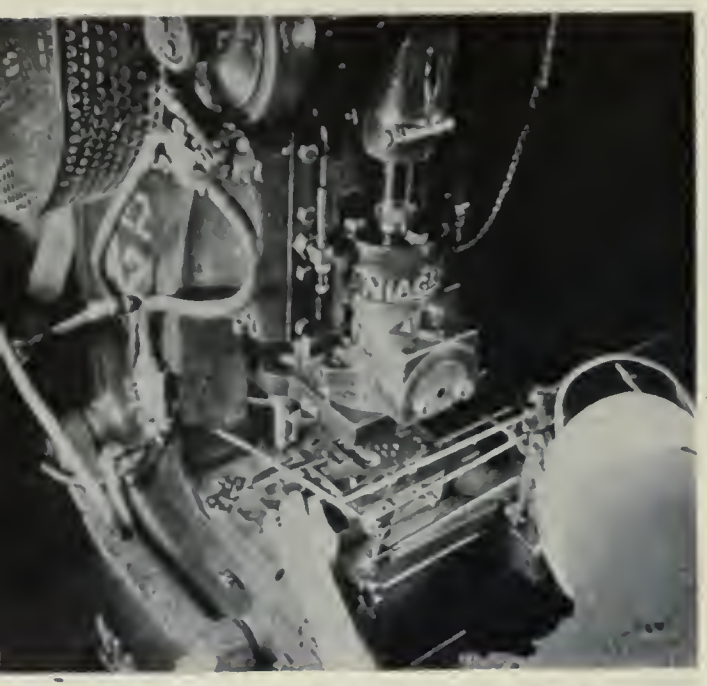
Milling

This operation requires the use of high-speed steel or sintered carbides of manufacturer's proper grade designation for plastics. Conventional milling is recommended unless the milling machine is designed for climb milling. For deep slots, side milling cutters should be used, as the material will bind if straight cutters are used. Using a high speed and slow feed causes the cutter to throw the chips away from the work and keep cutting. This will avoid excessive rubbing action which heats and dulls tools very quickly. The full depth of the cut should always be taken, when possible. Depending on the tool used, speeds of 300 to 500 fpm are recommended. Feed at the rate of 0.006″ to 0.012″ per tooth per cutter-revolution, depending upon the cutter used and the finish desired.

Shaving

Shaving can best be done with hollow dies of hardened tool steel, made to the desired outline. Shaving is accomplished with a brass or soft-steel plate or form on the ram of a punch press to force the material through the die—or, if compound dies are used, into the die. No less than 1/16″ should be removed at each shave. Whether to shave hot or cold depends upon the size and composition of the stock used. Phenol fibre up to ⅛″ should be shaved cold. From ⅛″ to ⅜″, shave hot. Vulcanized fibre up to 3/16″ should be shaved cold. From 3/16″ to 1/2″, shave hot. Fibre should be heated to 180° to 200° F for hot shaving. Whether shaved hot or cold, all pieces above ⅛″ thick should be given a light coating of oil or light cup-grease.

Laminated plastics may readily be worked in a punch press. Stock should be heated if more than ⅛″ thick



In handling plastics on a punch press, high-speed production can be achieved by the use of progressive dies

Here one must watch out for checking or breaking-in where thickness exceeds ⅛″ if punched. These faults can be partially or even totally overcome by heating. To obtain perfectly smooth edges, even on thin fibre, it is necessary to blank the stock a little larger than the required size and smooth with a shaving die.

Punching

For high-speed punching production, progressive dies are best. Compound dies are preferable for intricate pieces. For simple, vulcanized fibre shapes in 1/16″ or less, the cheapest steel rule dies are satisfactory. Horn dies are used in piercing tubes, but one must be sure the tube is a close fit over the horn. Where wall thickness is more than 1/32″ or holes are close together, or near the edges, heating is recommended. Punches should be sheared into dies to obtain minimum clearance. Compression stripper plates are highly recommended and should fit punches closely. Ample allowance should be provided in the die for frequent grinding, before starting the taper clearance. When working to close tolerances, making the piercing punches 0.002″ to 0.003″ larger for each 1/32″ in thickness allows for material shrinkage. This allowance depends on temperature and the size of the hole. Blanking punches should be 0.001″ to 0.008″ smaller than the required size of the blank. When working with thicknesses in excess of ⅛″, it it advisable to heat the stock to 180°-200° F.

Screw Machines

Vulcanized fibre and phenol fibre work well in hand and automatic screw machines but speeds vary on the two methods, and for different sizes of fibre. The following recommended speeds are based on the use of high-speed steel tools: (If sintered carbide tools are used, speeds should be from two to three times faster, if possible).

Hand Screw Machines

Under 1″ dia.	1500/2000 rpm
1″ dia. and over.....	800/1000 rpm

Automatic Machines

⅛″ and under	5000 rpm
¼″ to ½″	3600 rpm
Larger than ½″	2500 rpm

Feeds should vary with the specific operation. Drill at 0.005″ per revolution; turn at 0.007″; form at 0.001″ to 0.002″; cut off at 0.003″. Taylor Vulcanized Fibre and Phenol Fibre show excellent results and a fair life when used for cams on Brown & Sharpe automatics.

Drilling

High-speed steel, specially developed *Bakelite* drill is best. This has a slower spiral than a standard drill, with wide, highly-polished flutes which tend to prevent the chips from clinging to the tool. This lessens packing and over-heating. Sharp drills are essential if accurate holes are to be produced. If drill tends to grab or dig-in, or

Although jig-drilling of laminated plastics requires a certain amount of technique, once learned, it is simple

Holes bored in laminates with a drill press; high-speed or sintered carbide tools needed for maximum production

The turning operation requires close adherence to proper speeds and feeds and the correct grinding of tool bits

cause splitting, dubbing the lip of the drill and giving it more clearance will cause it to cut more freely. Drilling should be done at the highest speed possible, without burning the drill. A ¼" drill should be run at at least 2500 rpm and a No. 60 diameter drill could stand up to 10,000 rpm. One must be careful to feed drills slowly, never forcing them into the fibre. When drilling fibre, there is often a tendency for the hole to close in slightly, due to the resilience of the material. It is a good idea, therefore, before ordering jigs, to experiment a little with the material. Whenever possible, drilling should be perpendicular to the grain or laminations.

If it is necessary to drill parallel to the grain, support the fibre by a clamping device. To insure clean edges and freedom from burrs, work should be backed up with some hard material. When drilling deep holes, withdraw the bit frequently to clear the hole of chips. This will help to prevent burning of the drill.

Turning and Boring

For maximum production on these operations, it is best to use high-speed steel tools, or sintered carbides of the manufacturer's proper grade designation, being careful to keep tools sharp. Sintered carbides should be used in the

Grinding Tool Bits

	Back Rake	Side Rake	Front Relief	Side Relief	Second Relief	Side Cutting Angle	End Cutting Angle	Nose Radius
red Carbides	0°	0°	6°-10°	6°-10°	10°-15°	0°-20°	8°-15°	⅛₂" to as required
Speed	0°-5°	0°-5°	10°-15°	10°-15°	10°-15°	0°-20°	8°-15°	0" to as required

Speeds, Feeds*

	Sintered Carbides			High Speed Steel		
	Cut 1/16" to 7/32" Feed 1/32" (fpm)	Cut 3/64" to 1/32" Feed .020" (fpm)	Cut 1/64" to 1/32" Feed .010" (fpm)	Cut 1/16" to 7/32" Feed 1/32" (fpm)	Cut 3/64" to 1/32" Feed .020" (fpm)	Cut 1/64" to 1/32" Feed .010" (fpm)
Vulcanized Fibre	400	500	600	200	250	300
Phenol Fibre	400	600	800	200	300	400

*From these starting points, speeds can be adjusted downward or upward, as advisable.

holders designed for them. No lubricants are required. The accompanying tables of speeds, feeds, and grinding of tool bits will be helpful.

Swaging and Flaring

Swaging can be done in one operation in an ordinary punch press. Primarily used for making washers, swaging can also produce many other useful parts, provided the raised part is not too long. Flaring is done either by spinning the fibre in a screw machine or on a lathe, using a stationary tool to expand the diameter.

Riveting

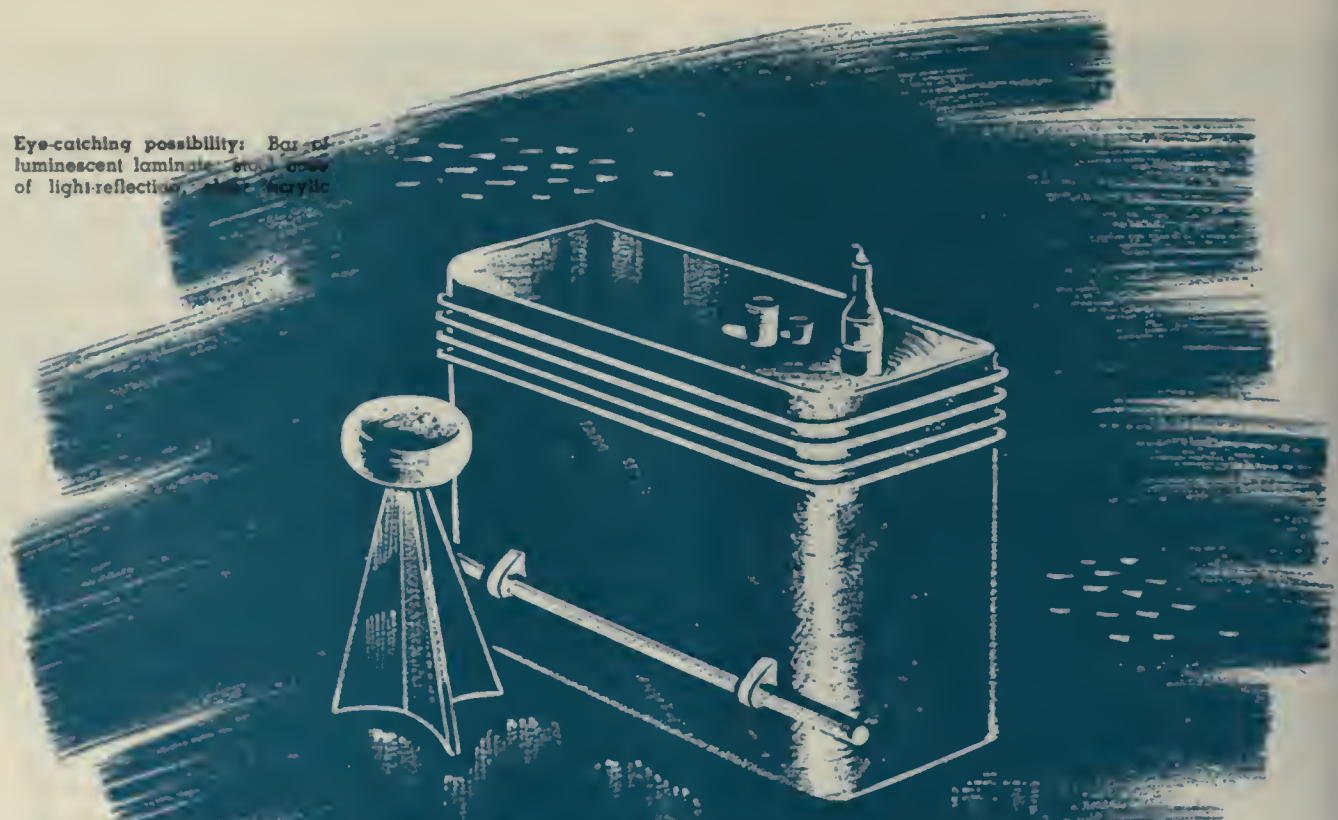
Wherever possible, it is best to avoid riveting paper-base phenolics. They will shatter under a vibrating riveter. Some success can be had with squeeze riveting or by spinning, if extreme care is used. Fabric-base phenolics, on the other hand, are well-suited to riveting by any method. In any case, it is always better to squecze rivets, especially with macerated moldings. On laminated, it makes no difference whether rivets are squeezed or vibrated.

Aluminum rivets in "A" condition are better suited for phenolics, since they require less driving pressure and are amply strong. Rivets in AD condition can be handled suecessfully by watching the driving pressure and not upsetting the rivet too much. In general, any A or AD rivet, if properly upset, will work well in fabric-base phenolics.

Direction of lamination and edge distance are important in riveting. Splitting is more likely to occur if rivet holes are drilled parallel with the laminations. Edge distances

(*Continued on page* 88)

No lubricant is needed in turning if tools are kept sharp. Here fibre is being turned in a turret lathe



Eye-catching possibility: Bar of luminescent laminate [illegible] of light-reflecting [illegible] acrylic

Trends in Post-War Design

By W. I. Beach

Chief Plastics Engineer
North American Aviation, Inc.

"Quality Control" Must Be Industry's Slogan to Assure Post-War Success

WITH most of the plastics industry, post-war trends are no longer a matter of conjecture. However, there were periods during the last 2 years when the burdens suddenly thrust upon a comparatively small industry by the needs of the armed forces were difficult and trying. In spite of being taxed to the utmost to satisfy the enormous demands for materials, the industry failed to recognize the golden opportunity offered plastics in newer fields heretofore denied it.

By dint of some individual ingenuity, but for the most part collective effort, an amazing assortment of resinous materials were developed and produced in a relatively short space of time. Also, keeping pace with these developments, a few important processes, designed to convert the latest materials into a diversified class of useful products, alleviated the critical scarcity of strategic metals.

Slowly and somewhat unobtrusively, plastics began to make an appearance in military airplanes in new and novel applications. At the same time, the United States Navy found satisfactory uses for plastics in essential capacities peculiarly suited to synthetic resins. The Quartermaster Corps, not to be outdone, applied plastics in no small proportions in the thousands of items furnished the Army. As a consequence, plastics by virtue of circumstances which disproved the complacent notion that the resources of these United States were limitless and overabundant, have given sufficient evidence of creditable performances in nearly every phase of the present national emergency. And most of the plastic items in service today by association or inference indicate a positive influence upon post-war enterprise.

Pitfalls

Recently, portentous occurrences relative to the plastics have indicated uncertain and difficult times in the post-war era, unless steps are taken to control them. In lieu of an educational program organized to acquaint the layman with plastics, adverse publicity instead has sufficed to impress him with all sorts of facts which truthfully are not too accurate.

Unfortunately, the propaganda submitted for sale purposes in some advertisements, pamphlets and technical papers, has included suggestive inferences which are definitely misleading. Far too often, bold statements are made expounding certain outstanding properties of a particular brand or type of plastics, whereas too few explanations pertaining to its weakness are given.

Then too, ridiculous comparisons made with other types of materials—for example, steel—are offered for public consumption without qualifying statements as to the limitations involved. Ordinarily, the reader, if he has only a scant knowledge of plastics and other materials, and particularly if he is impressionable, immediately assumes that everything can ultimately be made of plastic.

The fault certainly does not lie with him. And certainly the new processor, who, imbued with the glamorous appeal of plastics, takes it upon himself to misuse plastics, is not entirely to blame. If failure occurs with plastics employed in a promiscuous application, it is usually followed by discontentment and later bitter criticism.

Tenite steering wheel for landing craft molded by American Hard Rubber Company

The Helm of Invasion Craft

● Tenite wheels steer landing barges to the beachheads. They were at Anzio, Normandy, and Saipan.

Years ago, Tenite proved itself the ideal material for this important part in landing operations. Tenite was the most widely used plastic material for automobiles and speed boat steering wheels. And the same features which made it popular in peacetime—extreme toughness, weather resistance, pleasant feel, and speed of molding—also made it first choice for steering wheels of jeeps, Army trucks, and airplanes.

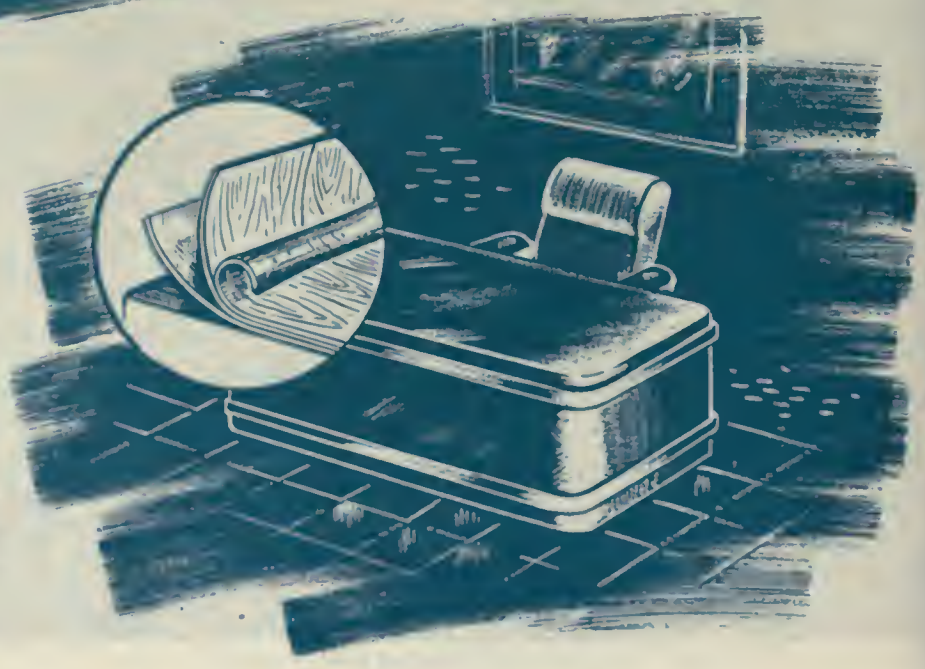
If your post-war product requires controls or handles—unbreakable, colorful, clean, and pleasant to the touch in either hot or cold weather—investigate the possibilities of molding them of Tenite. Write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Co.), KINGSPORT, TENNESSEE.

TENITE REPRESENTATIVES . . . *New York,* 10 East 40th Street. *Buffalo,* 1508 Rand Building. *Chicago,* 1564 Builders' Building. *Dayton, Ohio,* 305 Third National Building. *Detroit,* 904-5 Stephenson Building. *Leominster, Mass.,* 39 Main Street. *Washington, D. C.,* 1125 Earle Building. *Pacific Coast:* Wilson & Geo. Meyer & Company—*San Francisco,* 333 Montgomery St., *Los Angeles,* 402 Architects Building, *Seattle,* 1020 4th Ave. S.

TENITE

AN EASTMAN PLASTIC

Design for novelty item: Cigarette box decorated with one or combination of molding materials done in varied colors and patterns, wide range of clarity



Office ideas: Desk top is laminate of grain walnut-printed paper with clear urea coat to resist abrasion; metal foil beneath to dissipate cigarette heat

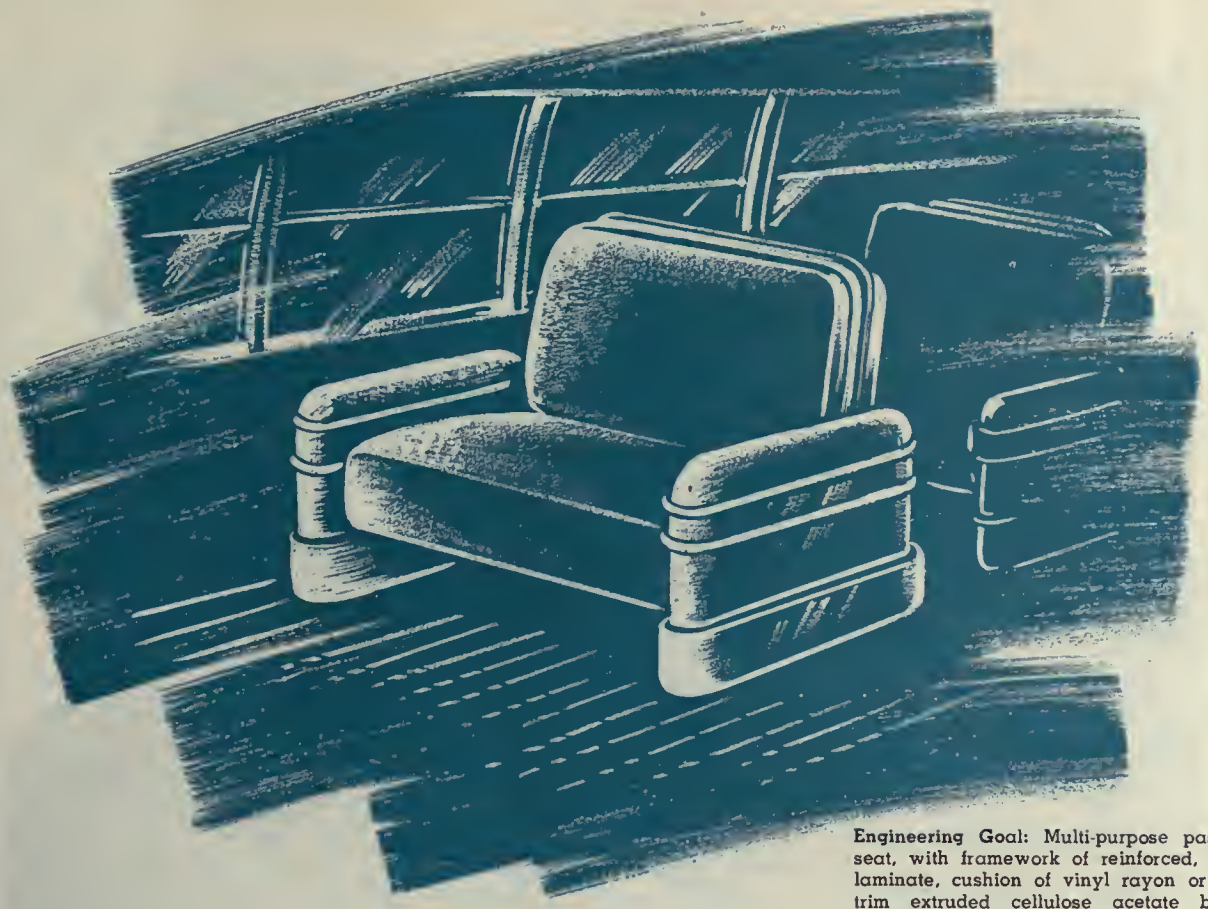
Public opinion will not necessarily be directed at the distributor, the processor or even the manufacturer of raw material. Irrespective of where the blame should fall, it takes very little imagination to realize how much plastics will suffer as a consequence of selfish management either as applied to publicity or business activities.

Another factor which undoubtedly will prove an obstacle to the formulation of post-war stabilization plans is the competitive attitude of the members of the plastics industry, particularly the newcomers. Prior to the emergency and before any noticeable influx of new molders and fabricators began, the industry's roster consisted of a fairly small group of pioneer members, most of whom have been in business for 15 to 25 years. These more conservative companies, which have contributed much to the development of plastics, know of the inherent limitations present in plastic materials. Consequently, they are extremely reluctant to trust the control of plastics in the hands of the inexperienced processor, of which there are hundreds engaged in war work today. By experience, the older group knows the consequences of misapplication of plastics.

On the other hand, most of the newcomers, lacking fundamental research and laboratory knowledge of the countless new materials produced today, have a different prospective of the post-war picture. And in view of the lush business at present, their policy is likely to be different as well. That this is no idle prophecy is borne out by numerous items manufactured in plastic now which cannot help but reflect upon the industry as a whole.

Some of these items were apparently conceived in complete ignorance of sound engineering principles. Others indicate poor knowledge or selection of the proper materials. And a few were unquestionably manufactured for distributors who, lacking something to sell, because of the scarcity of metals, hoped to hoodwink the public into believing that plastics substitutes are as good or better.

Furthermore, encouraged by the fact that the consumer has ample funds to buy merchandise long denied him and anticipating a spending spree when the allocation system is abandoned, it is already evident that some vendors are unwittingly making plans to flood the market with spectacular plastic commodities. The odds are against



Engineering Goal: Multi-purpose passenger seat, with framework of reinforced, molded laminate, cushion of vinyl rayon or nylon; trim extruded cellulose acetate butyrate

the possibility that a very large proportion of these will survive in the face of determined competition by manufacturers of metal products, either on the basis of cost or serviceability.

Improved Techniques

Out of the war effort have come remarkable developments which hold considerable promise for the future. One of the first and foremost innovations is the introduction of low-pressure and contact resins. Forming or laminate molding of various high strength materials, such as paper and glass cloth, impregnated with either type of resin into simple or complex objects may be accomplished with inexpensive tooling and equipment. Also, the size or shape is not confined to die and press capacity, as is the case with high pressure molding of laminating materials. Parts as large as droppable fuel tanks, radar housings, tail cones, ducts and scoops of all description manufactured for combat airplanes are sufficient cause for post-war anticipation.

The high frequency heating units have become a great boon to the molding fraternity. With these machines working efficiently to facilitate the making of preforms, the operating cycles of compression and transfer molding has been appreciably reduced. Automatic molding machines are doing a sterling job of speeding up production in some plants. A few molders who use the conventional hydraulic presses have disposed of platen heating in favor of electrical heating. Electrical strip heating units are embedded in the dies. It is said that this method is less expensive and much faster than the former method, which requires too much time to bring the platens up to curing temperature.

Special prepared high-strength filling materials have increased the toughness and physical properties of both high and low pressure laminates. Some, such as the glass cloth variety, when impregnated with allyl alcohol resins, the melamines and others have been tested to strengths comparable to that of aluminum alloys in tension and even greater when the alignment of the fiber in adjacent layers was made parallel to the direction of the load.

Several types of adhesives, having low pressure and temperature application characteristics, add much to the ease of fabrication. Plastics have always presented a difficult assembly problem. By virtue of their low yield properties, characteristic of the thermosetting resins and the rigid thermoplastic compounds, attachments made by riveting and in some cases even with bolts, frequently fail by cracking of the material at the rivet holes or cold flow under pressure of the bolt head. All of these and others, too numerous to discuss in detail here, offer better performance and efficiency in the post-war production of plastics.

Advantages and Disadvantages

The first concern of the plastics engineer when dealing with a new and untried project is with the limitations of the material proposed for the job. Assuming that any one or a combination of potential properties possessed by plastic materials enhance the value of a prospective application, what then are the undesirable characteristics which under certain conditions might impair its overall function?

If engineered properly, allowances should be made for advantages and disadvantages to be expected of heat-hardening and heat-softening plastic materials. It is noteworthy that for each advantage there are an equal number of disadvantages. This does not necessarily signify that all or anyone of the disadvantages will curtail the use of plastics in a feasible application. They simply represent the various hazards which may create a functional failure and directly or indirectly lead to an economic set back.

In any event, the designer or engineer can not afford to ignore these factors. Ordinarily they needn't become

(*Continued on page* 91)

These first-aid dressings are packed in a container exemplifying plastics-foil laminates. Asphalt mounts kraft paper to lead foil, which is held by cellulose nitrate to cellophane

Metal Foil and Plastics in War Packaging

By Arthur Biddle
Director of Research, Reynolds Metals Co.

Plastics and Other Materials in Laminated Containers Strengthen Each Other, Open New Fields for Development

IT IS just about time that we came down to earth and soberly considered plastics and similar materials about which fabulous post-war legends have been built. If one is to believe everything he hears, we will have automobile bodies going on the production line out of a nozzle of an extruder. Beans will be baked in plastic pans; houses will be made of plastic construction, and a host of other things will find creation in one form of plastics or another.

A common sense review is certainly in order at this time, as we cannot expect that the non-plastic industries will close their doors and permit plastics to take over. At present, many companies are mapping their future, and in so doing are enlarging upon the qualities of their own products. In many instances they are spreading themselves to such an extent they cannot see the inherent value of other meritorious products. They fail to realize that in cooperation there is financial strength and fair profit. The wood, metal, textile, paper, plastics and many other industries must not lose sight of the fact that materials other than their own will be offered to the consumer and will be sold.

It is one thing to warn of a condition and it is another to show how to overcome that condition. If each manufacturer, instead of trying to force his product on the

POINTING THE WAY TO NEW MARKETS THROUGH *Mosinee Paperology*

Many materials born of war necessity have "made good" to an extent far beyond expectations. New product advantages create broader markets. Alert manufacturers are appraising the progress of paper in its adaptability to many products.

That is where Mosinee Paperology comes in, to point the way to new markets by improving products, reducing costs, expanding production . . . by engineering the proper properties and characteristics into paper to meet definite specifications in terms of the product and production processes. For instance, wet strength, controlled absorbency, definite relationship between cross-direction tensile and machine-direction tensile, accurate caliper, maximum uniform strength, uniform weight for maximum yardage, or other essential characteristics can be engineered into paper by Mosinee Paperologists. Mosinee is ready now to help you "make the most of paper" in seeking new markets.

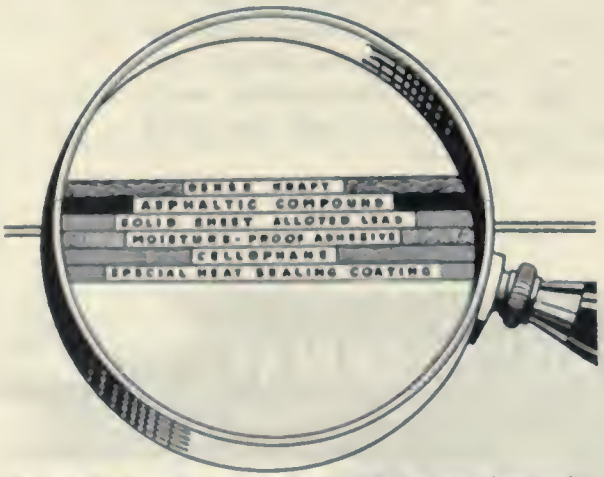
MOSINEE PAPER MILLS COMPANY
MOSINEE • WISCONSIN
Essential Paper Makers

Please address your letter "Attention Dept. E"

Kraft-asphalt-lead foil envelope sealed with ethyl cellulose

market, to the exclusion of other products, will coordinate his efforts with the manufacturers of related materials, some startling post-war prospects are in store. As an instance of how this can be done, let us look at the accompanying chart. It will be noticed that plastics and aluminum do not clash, they complement and strengthen each other in many fields.

One of the greatest sources for post-war argument and competition will be in the packaging field. Here, there will be an opportunity for a free-for-all between the plastics, aluminum foil and paper manufacturers. Manufacturers of glassine, waxed paper and other webs will come forth with arguments and tests to prove them. The same thing may occur with the foil industry and with the synthetic filamentary materials producers. If the argument continues, all of them may wake up one morning and find many shiploads of laminated materials from Germany and Japan, whose industries also have means of making aluminum, paper and plastics and will do everything they can to flood our country with their materials—trade treaties and tariff walls notwithstanding.



Typical package lamination showing four plastic layers: Asphalt, adhesive, cellophane and special heat-seal coating

We know how our ten cent and department stores were flooded with Japanese plastics before the war; the same thing was true with chemicals and scientific goods from Germany. Their merchandise will be cheaper, but may also be inferior to ours and, if they are used indiscriminately, may give our better products an unfavorable name.

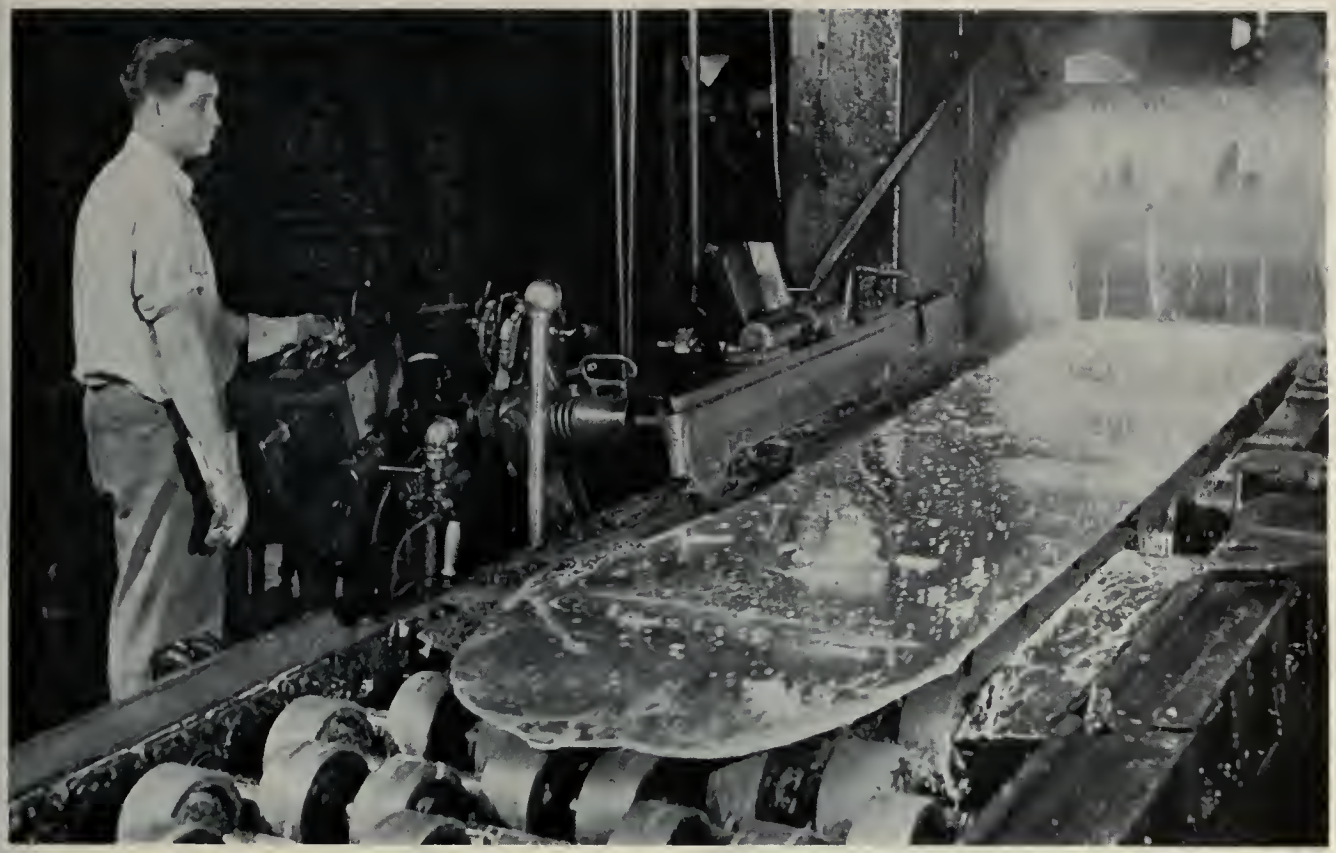
The smart thing for us to do is to have a meeting of minds to see just what each product will do; to combine these qualities so that other superior products may be made to answer certain definite needs in the many fields in which plastics, paper, wood, textiles, etc., may not need to play a lone game in the future. This will at the same time be our best answer to inferior imported products.

While there are many different industries in which both plastics and aluminum play a considerable part in their relation to other materials, for the time being we will only discuss the packaging field. There are certain products that do better when packaged in rigid containers, such as those made from paperboard, paper, plastic, and foil combinations, while others must have flexible wrappers. Some articles may be packaged suitably if wrapped in transparent coatings such as cellophane and the countless other transparent filamentary materials. On the other hand, many food products must be protected from heat, sunlight and other aspects of weather. In this instance, aluminum foil alone or in combination with paper or plastics, is preeminently suitable. The manufacturers of cellophane, cellulose acetate, ethyl cellulose and many other similar products, will rightly advance their own developments whatever their individual qualities may be. Discreet consideration should also be given to their shortcomings.

When the war started, the packaging problem graduated from the eye-appeal, "keep your breakfast food fresh" stage to the stark reality of supplying war materiel to our military men in the right place at the right time and in useable condition. Every packaging manufacturer was given a chance to submit his products, which many of them did with varying degrees of success. The writer was a member of one of the groups when aluminum being critically needed for airplanes was restricted for civilian use. Another material this company had to work with was lead foil. Every packaging material known was inspected and its peculiar attributes were tabulated. Even new alloys of lead were tested. Chemical and physical qualities of countless glues, plastics and laminating compounds were considered. Whole plants, formerly busy on peace work, were turned into pilot plants until a packaging material was made that was satisfactory for war material. Lead alone would have been useless but lead, paper, plastics and textiles, all played their part in the making of the perfect wrapper.

If wholehearted cooperation of this type can accomplish so much in time of emergency, there is more reason for the same coordination of industrial effort in time of peace.

There are instances when aluminum foil, in itself, makes a satisfactory loose wrapping material; but its greatest usefulness occurs when it is coated or laminated with other materials. Besides the use of plastics with aluminum, many thousands of tons of paper are laminated to foil to give it toughness, body and weight. This same paper would be useless as a moisture barrier if used alone as a wrapper. Large quantities of cellophane, acetate, rubber hydrochloride and vinyls are used as coatings and as filamentary laminations to aluminum foil in order to add qualities of extensibility, toughness, etc. The same amount



An early stage of the rolling process in the manufacture of aluminum foil

of plastics material could not be used alone to package the same article before the foil was laminated to it. The flexible metal has added, among other things, properties of absolute moisture-proofness and insulation from heat caused by the destruction action of infra-red and ultra-violet rays. In other words, they complement each other.

Like other scientific developments, the plastics industry has also had its growing pains, similar to that experienced many years ago by metallurgy. Alloys were made haphazardly; no two runs were produced with the same results. Then research brought order out of chaos, so that now metallurgy and especially that part which pertains to aluminum has evolved into a slide-rule science wherein required properties are computed according to specifications.

Until recent years, the average chemist reached out blindly to his shelf of plastics, resins, plasticizers and solvents, and with a naive faith in miracles hoped to concoct something he was working for. Sometimes he arrived at a satisfactory end-use; more often he did not. The unenlightened still do their compounding in this fashion but the plastics science has graduated and it is no longer necessary to spend months of blind research in order to get a usable result. Every user of plastics, no matter how small he is, has many million dollar laboratories at his command. By this is meant the services rendered by the research and development laboratories of the plastics and adhesive, as well as the aluminum, industries.

Gone is the day when a manufacturer may make a product and leave it to the consumer to find out how to use it. The manufacturer now, before releasing his article to the public, has spent a long period of development on its use in the many other fields of industry, and he has given it every possible physical and chemical test. After the results are proved and tabulated, they are given to the consumer.

(*Continued on page* 98)

Plastics and aluminum are interdependent in many fields

ALUMINUM

		PLASTICS
Metal-wood veneer laminations; plywood combinations; foil insulation coverings, aluminum casings for wood forms: wood-plastic- aluminum furniture.	WOOD	Plastic pulp fillers; plywood impregnations with and without metal and textile plies. Source of alcohol, acetic acid, formaldehyde, numerous resins and plasticizers used in plastic industry.
Aluminum coatings; Metal-paper, metal-paper-plastic laminations, both flexible and rigid, with and without aluminum foil and sheet laminations. Foil-plastic-paper combinations make excellent insulation.	PAPER	Wet strength beater size; tub sizes; all types of coatings of a solvent, extruded, cast, and filmentary nature. Paper-plastic-textile molded laminations make silent, durable machine parts.
Metal-textile cloths. Aluminum powder lacquers for coatings. Foil-textile insulation.	TEXTILES NATURAL	Plastic sizings, coatings and adhesives. Fireproofing, leather substitutes for wearing apparel and upholstery. Pure cotton the basis of many plastics.
Aluminum the basis of many chemicals. Aluminum equipment used in chemical industry and manufacture of plastics.	TEXTILES SYNTHETIC	All synthetic fibers, textiles are plastic by nature and processing. Plastic is made into threads and woven into clothing.
Aluminum made from bauxite and cryolite, an important mining industry. Other crude materials (salt and sulphur and lime) also used in aluminum industry.	EARTHY MATERIALS	Plastic industry consumes large quantities of sulphur as sulphuric acid, chlorine from salt. Clays are used for fillers in plastic molding compositions and in urea formaldehyde water paints.
Much acid, caustic, chlorine gas, carbon and other chemicals used in the manufacture of aluminum and its products.	HEAVY CHEMICALS	Nearly all chemicals this industry has to offer are used to make plastics, plastic products.
Without steel, copper, lead and other metals to make machinery and equipment, aluminum could not be made into products. This industry is a good steel customer.	HEAVY METALS	Manufacture of plastics require stainless steel, copper, lead and other non-corrosive equipment.
Petroleum oils and solvents used to clean aluminum foils and sheets. Asphalt, paraffin, resins, and other coal tar derivatives used in foil-plastic-paper-textile-laminations.	COAL PETROLEUM	Benzol, toluol, naphtha solvents, indene-cumar, other resins, pitches, waxes used to dissolve plastics, laminating, in plastic adhesives.
The aluminum reduction and rolling mill at Lister Hill, Ala., requires more electric current than is used in a large city. Much electric apparatus also used.	ELECTRICAL INDUSTRIES	Electric industry of today could not exist without use of plastics as insulation for wires, panels, apparatus. Current is needed in plastic industry.
Glass brick and windows in construction need aluminum for framing. Aluminum also used in manufacture of glass.	CERAMICS	Sunlight-resisting plastics gave birth to safety glass. Glass used in making chemical equipment to produce plastics.
Aluminum powder for paint. Aluminum stearate for varnishes, aluminum metal for cooking equipment.	PAINTS VARNISHES LACQUERS	Plastics with and without certain oils or resins are basis of most lacquers and varnishes.
Agricultural products require aluminum utensils. Cotton fibre when adhered to aluminum foil with water-resisting plastics makes excellent house insulation.	AGRICULTURE CHEMURGY	Cellophane, cellulose nitrate, many other plastics made from raw cotton. Chemurgy, i.e., production of plastics from farm products, and production of alcohol is a twentieth century development.

Welding Thermoplastics With High Frequency

By Dr. H. P. Zade

Research Engineer
Arc Manufacturing Co., London

Charts Find Heat Distribution For Electrode Arrangement, Ease Joining of Irregular Shapes

ONE of the least known techniques developed during the war period is the welding of high dielectric materials by means of radio frequency. This process, which has permitted a far more uniform heating of materials, has been surrounded by considerable secrecy. However, there are certain facts about the process which can be disclosed.

Previous writings have dealt almost exclusively with the applications of this process to molding powders, most of which are thermosetting. Conventional practice is to pre-heat a pre-form before transferring it to the mold, thus saving considerable time in the molding operation as well as achieving highly uniform heating of the item being molded.

Thermoplastics, however, being reversible, comprise the bulk of materials to which high frequency welding can be successfully applied.

The author is shown here testing welding transformers

Fig. 1. Power-driven machine for continuous welding of sheet plastic with roller pressure

Dielectric heating is based on the fact that dielectrics when subjected to the electric stress set up in a rapidly alternating field heat up due to a kind of "molecular friction." This phenomenon is a characteristic of all dielectric materials and the term "dielectric loss" is used to express the percentage of energy consumed by the material and thus appearing as heat.

In most cases the energy is applied to the object to be heated through the medium of a condenser, the plates of which are connected to a high frequency oscillator. The rapidity of heating depends on the voltage applied to the condenser plates, on the geometric shape of the condenser, and on the frequency. This process finds an analogy in the resistance welding of metals, since pressure and heat are required to effect a joint.

There are two main processes of applying high frequency heating to the welding of plastic materials—continuous and discontinuous.

The machines used for continuous welding of sheet plastics are similar to ordinary seam welding machines; they make use of positively driven rollers between which the material is passed for welding while pressure is applied to one of the rollers. Such machines have been developed in England during the last few years and are mainly intended for the welding of polyvinyl chloride sheets and similar materials varying in thickness between .005" and .030" at speeds ranging from 12" per min. to 72" per min. A frequency of 50 megacycles is used. The machine illustrated in Fig. 1 is completely self-contained, and includes a small, high frequency oscillator built into the frame work. All controls are easily accessible to the operator and the actual operation is much on the lines of a power-driven sewing machine.

The width of the welding seam depends on the profile

(Can you name the plastic parts that make up this "bird"? See chart below)

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Our designers, engineers and research men have had long experience in the development of plastic products.* They have worked closely with the leading manufacturers of raw materials—have immediate access to all the latest developments. And with equipment to produce by any one of the modern fabricating techniques—compression, injection, extrusion, lamination or sheet forming—you can be sure your product will be handled in the most efficient and economical way.

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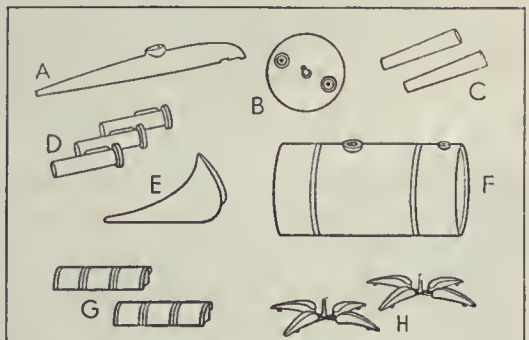

(a) Wing tip—laminotion; (b) Distributor part—compression; (c) Pitot tubes—laminotion; (d) Flashlight cases—injection; (e) Foiring—laminotion; (f) De-icer fluid tank—laminotion; (g) Refrigeratar handles—injection; (h) Door pulls—injection.

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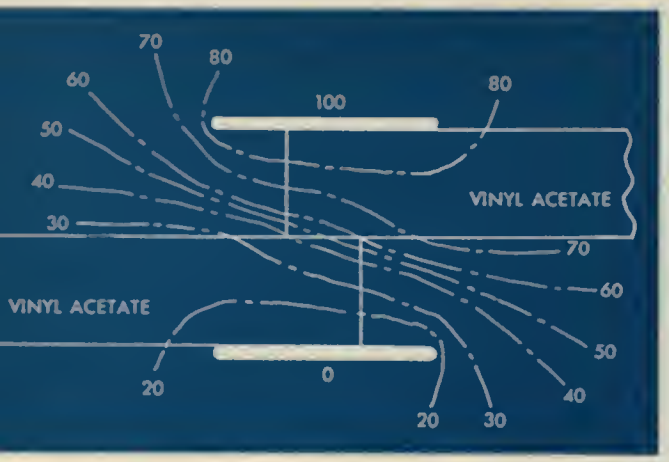

Fig. 2. Field plotting device for lap welding problem, with two blocks clamped between two flat electrodes

of the rollers. These are easily interchangeable and can be embossed to provide a continuous record of identification numbers, or the like, in the welding seam. One of the rollers is spring-loaded, the spring being adjustable to obtain the correct squeezing pressure for the material as it passes between the rollers in a softened condition. Welding pressure, high frequency current, and speed are interrelated and the success of the method depends on the correct setting of all three.

Apart from the welding of sheets of thermoplastic materials, successful attempts have been made to weld plastic impregnated fabrics, either using the layer of resin impregnation to form a bond with the cloth or inserting a thin tape of polyvinyl chloride to soften the material and effect the bond.

In a number of cases it is preferable to weld a limited length of seam at the same time, instead of using the continuous seam welding method outlined above. A good example of this is the mass production of weatherproof bags from two sheets of plastic. Here a welding fixture not unlike a press tool can be used. The fixture has to be made from high quality insulating material, and the shape of the seams to be welded must be determined by the shape and disposition of metallic electrodes embedded in the bottom and top platens. The sheets of plastic are mechanically squeezed between the electrodes and high frequency current is passed through them. Pneumatic, hydraulic or mechanical systems of closing the press can be used but as the finish of the welding seam depends on even distribution of pressure, it is advisable to use springs in at least one of the platens to obtain uniform pressure over the welding area.

The choice of frequency in the case of these pressure welds is determined by the area to be welded simultaneously. The area of the opposing electrodes determines the capacity of the jig and generally speaking the higher this capacity, the lower the welding frequency should be. The reason for this can be found in the following considerations:

In order to obtain the full output of a high frequency oscillator, the "work circuit" has to be tuned to the frequency supplied by the oscillator. A minimum length of leads connecting the oscillator to the job is unavoidable. These leads represent inductances and the value of the inductance cannot be reduced below a certain level. On the other hand, the welding fixture itself acts mainly as a condenser and for reasons of shape and size this capacity cannot be kept below a certain figure. The "work circuit" has its electrical characteristics determined by these two facts, and if the frequency used is very high it may not be possible to tune the circuit fully to the oscillator.

Although in the case of the continuous seam welder the capacity between the two rollers is extremely small, conditions are different for fixtures used for large area pressure welds. Frequencies very much lower than 50 megacycles have to be used to obtain economic welding conditions. Seven to 10 megacycles have been found to yield good results in a number of practical welding problems.

The development of heat in a diclectric material of a given composition and at a given frequency, varies with the square of the applied field strength. The easiest way to increase the heating effect under given conditions would be to increase the voltage applied to the welding machine. There is, however, one restriction—the electrical breakdown strength of plastics limits the stress which can be safely applied to a given thickness of material without the danger of puncture. Particularly in the case of extremely thin materials with a comparatively low breakdown strength, it is preferable to increase the frequency than to apply higher voltage.

When thicker pieces have to be welded, the distribution of the electrostatic field is of importance. If the condenser electrodes are plane and of infinite size, the field strength between them is a linear function of the applied voltage. For example, if we were to take a piece of plastic of ½" thickness and insert it between flat electrodes, applying 10,000 v, the field strength would be uniformly distributed and have a value of 20,000 v per in or 20 v per mil. If, however, the electrodes were curved, the distribution of the field strength would be non-uniform and the heating effect different in different places of the condenser. The shape of the field can be represented by drawing a number of equi-potential lines between the electrodes; that is,

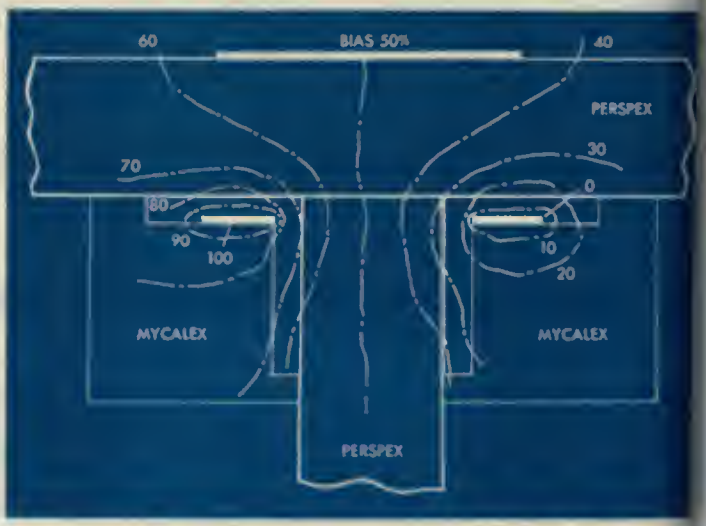

Fig. 3. Elaborate design of "T" weld, using three electrodes, one biased at 50% of total potential

co-ordinate points of the same potential. These are then joined by a continuous line. The electric field strength for each point is found by drawing into this diagram lines of force which are always at right angles to the equi-potential lines.

For simple shapes of electrodes it is possible to compute mathematically the distribution of the electric field, but in most practical cases the problem of finding a mathematical solution for a system of irregularly shaped electrodes is rather involved, and it is preferable to use an experimental method for the determination of such field diagrams. Although methods have been developed to measure field strength or equi-potential lines in actual high frequency condenser fields, these are by no means simple and it was

(*Continued on page 95*)

FOR ALL INDUSTRY

When any manufacturer opens his eyes to the full possibilities of synthetics and looks around for a supplier, his greatest need is one with the ability to produce parts or complete products—of the one right plastic—in any required quantity. That ability Amphenol offers to the fullest degree.

One of the pioneer plastic molders in the country, Amphenol is today equipped with batteries of compression and injection molding and extrusion machines. Many hundred thousand feet of UHF cable come from the extrusion machines each month. The Amphenol Machine illustrated is the largest of a battery of injection molding presses.

And—Amphenol's engineering and designing departments and testing laboratories are at the service of Amphenol customers for counsel and help.

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Manufacturers of Plastics for Industry, UHF Coble and Connectors, Flexible Conduit,

These buttons of clear acrylic material may be fashioned simply by undercutting, and in addition may be painted in black or a bright color along undercut lines to make designs stand out

Plastics in Quality Jewelry

Demand for Beauty of Plastic Ornaments Gives Industry Good Opening for Expansion into Higher-Priced Lines

WITHIN the past 6 months a definite demand for higher price lines of costume jewelry and other ornaments made of plastics has manifested itself, according to manufacturers serving the better specialty shops and department stores. In this field, anything up to $1 is considered popular-priced, and since many plastic items could be made to sell for any amount from 5c to $1, the counters of the chain stores have sprouted a profuse and colorful variety of them. The American public, always eager for novelties, has bought them up by the handful.

Some of these products have been indifferently designed and poorly fabricated, but many of them are good and well worth their cost. The result is that the public no longer regards them merely as novelties, but as staple commodities. An active demand for them still continues.

Now that the novelty of plastic jewelry has worn off, the eternal desire of human beings for improvement of the things they like is making itself felt. Along with the 5c-$1 merchandise, pins, earrings, hair ornaments and the like retailing up to $5 are making their appearance. The Hoffman Manufacturing Co. of New York, which produces the objects illustrating this story, started out with a popular price line. Of their outstanding numbers they have sold as many as 6000 gross a season. But, having been asked many times for items of higher quality and fortunately having the designing talent to make them, the firm is now rapidly turning its facilities in that direction. (*Continued on page* 90)

In the quality jewelry line, acrylics lend themselves to presentation as models of natural objects and scenes and in abstract patterns, with strong eye appeal

These figures illustrate how intricate shapes can be used in designs for brooches and table ornaments. Note bows spotted with color, plaid painted over acrylic

MOLDED *Condensers*

MOST small-size high-quality mica capacitors (or condensers) are molded into a homogeneous phenolic resin casing. Several types of *Bakelite* phenolic are seen in this photograph at the Aerovox Corp. plant in New Bedford, Mass., the brown variety being employed in the manufacture of standard capacitors, the yellow type (which is mica-filled) encasing low-loss units, and the red variety being used exclusively for the high-stability silvered mica types.

Capacitor manufacturers customarily identify the properties of the plastic by the color of the material. Actually, there is no necessary correlation. Amber yellow, for instance, is usually associated with low-loss properties, but many amber yellow plastics have no low-loss properties whatsoever. Conversely, pigments may be added to plastics without affecting their basic properties. So deep-rooted, however, is the custom of selecting capacitor parts on the basis of color, that one company molds many diverse capacitor parts of *one* color, paints identification marks on the surface. Color codes, in addition, are painted on, in the form of three or more vari-colored dots, as a means of identifying the actual capacity of the unit.

Types of Materials

Irrespective of color, two general types of *Bakelite* molding materials are used in the manufacture of capacitors. They are: general-purpose wood-flour filled phenolic molding materials and high frequency insulation materials (low-loss mica-filled phenolic molding materials). The general-purpose material is standard for ordinary applications — has excellent electrical properties, very good appearance and water-resistance. Low-loss material is recommended where low power factor, high dielectric strength, high resistivity, and low water absorption are desired.

The various *Bakelite* materials come to the capacitor factory in the form of molding powders, which are first formed into rectangular tablets or "pills" by cold preforming machines similar to the presses used to make aspirin tablets. In the molding department, one preformed tablet is placed below, another above each assembled capacitor element in a multi-cavity steel mold. A little of the phenolic powder is then sprinkled into each cavity to fill up the gap around the tablet; and the mold is locked and inserted into a hydraulic press where, under several thousand pounds' pressure and a temperature of several hundred degrees, the tablets and powder melt and flow around the capacitor elements, enclosing them entirely in a hard, resistant jacket. END

Versatile polyethylene takes varied forms: Above, as cable insulation, thin knotted tube, thick tube bent by hands, calendered sheet and molding powder; below, as coated paper, in woven tubes and translucent mats, and in the form of monofilaments

Polyethylene

A High-Dielectric Thermoplastic With Extensive Market Potentials

By C. S. Myers
Development Engineer
Carbide and Carbon Chemicals Corp.

DEVELOPMENT of a plastic called polyethylene by the Plastics Division of Carbide and Carbon Chemicals Corp. promises to open up whole new fields of applications which are varied and widespread. A thermoplastic of unusual characteristics, polyethylene already is being applied practically in widespread war uses, and seems headed for expanded peace-time application in industrial, electrical and packaging fields. Its excellent properties, especially electrically, virtually assures this.

As an example of what polyethylene already is contributing to the war effort, it is being used extensively as insulation on coaxial cable for radar, on Army assault and infantry wire, and on underground cable. Molded, it finds relatively restricted use at present, in grommets, seals, gaskets. In addition, many uses of the material as a packaging film for food are being investigated, but time has not yet permitted its standardization for this application. Post-war, there is promise of its widespread use in television, in chemistry and medicine, transportation. The accompanying list gives a number of suggested applications, no attempt, however, being made to weigh the economies involved.

Electrical Characteristics

As pointed out above, polyethylene is now used electrically, and its success in this field is understandable when its properties, electrical and otherwise, are studied. As an example: its specific gravity of 0.92, is less than that of water; it is practically unaffected by changes in electrical frequencies, temperature or humidity; and it has high resistance to the effects of almost all chemicals at room temperature. Its moisture absorption percentage is exceedingly low; its softening point is above 250° F, and its brittleness temperature is —95° F. In addition, it can be formed by all the standard methods used to form other thermoplastics. Its other properties are shown in Table 1.

Rods, tubes and a variety of other shapes may be produced of polyethylene by standard plastics extruding equipment

One of the most interesting of polyethylene's new uses is as insulation on the Army assault wire, mentioned above. This telephone and signal wire is carried forward by shock troops, often on their backs. In the construction of this wire, polyethylene has been advantageous first because the light weight of the insulation, accruing both from its specific gravity and the practicability of thin-walled construction, makes it possible to carry larger reels of the wire, or the same sized reels with greater ease and rapidity. Then, polyethylene's electrical properties, together with its resistance to the effects of moisture, oil and sunlight, makes possible greater distances between relay stations. Thus, less time is required in rigging the circuits. Also, regardless of the weather, the electrical properties will not be materially affected, so that reception, already improved, will remain clear for extended periods. In fact, the insulation is so stable that the assault wire can be picked up and used again when the heavier infantry wire, also insulated with polyethylene, is extended to the forward areas.

Polyethylene used as the insulation on underground telephone wire installations, being unaffected by acids or moisture in the ground, requires no braiding over the insulation, thus saving production time. The wire is merely laid in the ground in unusually long lengths. In addition, polyethylene does not support fungus growth.

As may be expected from the properties in the table, the major fields of application for this material up to now have been been electrical. It is true that several injection molded products, taking advantage of the high

FRONT COVER

Also illustrating the varied forms and uses of polyethylene this month, in addition to the photos shown on these pages, is the cover. Against a background of embossed and cloth-covered sheets are presented molding powders and molded discs and squares, demonstrating the color possibilities of the material. These are seen through varying thicknesses of polyethylene film. The molded collars attached to runners and sprues are component parts of a valve.

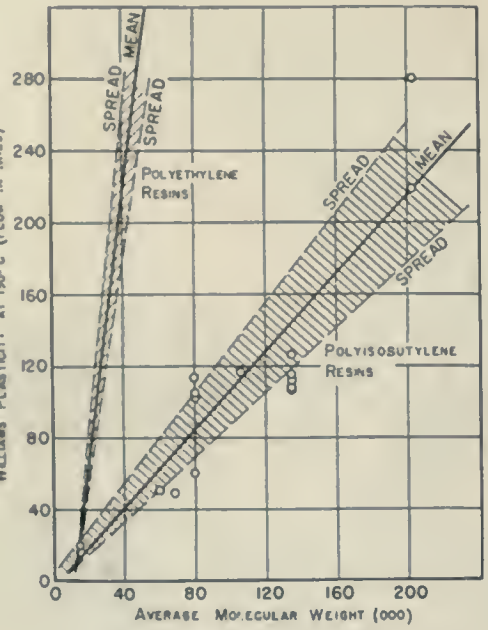

Fig. 1. Comparison between plasticity and average molecular weight of polyethylene, polyisobutylene resins

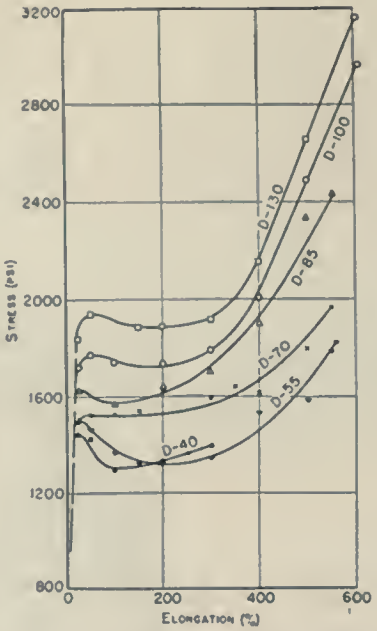

Fig. 2. Diagram illustrating stress and strain for polyethylene resins with increasing molecular weight

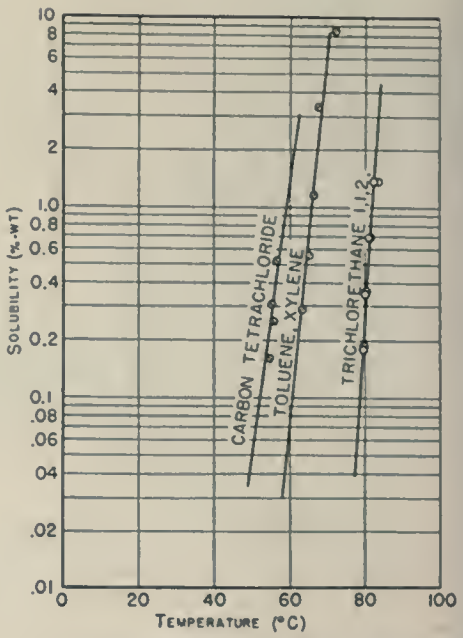

Fig. 3. Solubility of DYNH polyethylene resin in carbon tetrachloride, toluene-xylene and trichlorethane

softening point and excellent cold resistance of the material, are in use, but these have taken the form of the less glamorous grommets, gaskets and seals.

Although numerous grades of polyethylene resins are practical, only one grade is being produced regularly at present. As produced, they are inherently flexible, translucent white in color. They are straight-chain polymers of ethylene, produced by direct polymerization of liquid ethylene at high temperatures and high pressures. It is possible to produce the resins in a wide range of molecular weights, each essentially normal, or linear, in molecular structure. The characteristic structure of the polyethylene resins is as follows:

$$\begin{bmatrix} H & H & H & H \\ C & - & C & - & C & - & C \\ H & H & H & H \end{bmatrix}_n$$

Their flexibility is essentially independent of the average molecular weight of the resins, and is approximately equivalent to the flexibility at room temperature of Vinylite resin VYNW plasticized with 20% Flexol plasticizer DOP.

The resins are crystalline in structure. Thus, the tensile strength of the fabricated members may be increased by orientation and cold working. Transparency is also increased somewhat by orientation and cold working.

Dyes and pigments may be added to the resin to produce a wide range of colors of exceptional brilliance.

Polyethylene resins soften sharply at a temperature of approximately 108° to 112° C. Resins of low average molecular weight will change from a solid to soft plastic mass in this temperature interval. Resins of higher average molecular weight begin to soften in the same temperature interval, but the softened resin is quite viscous above the softening temperature range. Consequently, the viscosity of the softened polymers above the softening temperature range of 108° - 112° C is dependent upon the average molecular weight of the resin.

It has been determined that the flow height of the resin, as determined by the Williams parallel plate plastometer, is directly proportional to the average molecular weight of the polyethylene resins. (See Fig. 1.) For this reason the resins are defined by flow height as determined in the standard manner.[1] As an example, the grade

[1] Journal of Industrial and Engineering Chemistry, Vol. 16, No. 4, P. 362, 1924.

Table I: Properties Summary for Polyethylene Resins at Room Temperature

Grade designation	D-40	D-55*	D-70	D-85	D-100	D-130	D-145
Specific gravity	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Stiffness in flexure (psi)							
25° C	18,000	18,000	18,000	18,000	18,000	18,000	18,000
0° C	30,000	30,000	30,000	30,000	30,000	30,000	30,000
—25° C	66,000	66,000	66,000	66,000	66,000	66,000	66,000
—50° C	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Yield strength (psi)	1,430	1,480	1,490	1,600	1,700	1,830	1,720
Hardness (Durometer Type D)	52-54	52-54	52-54	52-54	52-54	52-54	52-54
Flammability	Slow burning	Slow burning	Slow burning	Slow burning	Slow burning	Slow burning	Slow burning
Brittle temperature (°C)	—55	below —70	below —70	below —70	below —70	below —70	below —70
Notch impact strength (ft lb/in)		>1					
Te (°C)		—40					
Tear strength (psi)	440	500	540	560	580	605	690
Abrasion volume loss (standard S rubber = 100)	85	55	50	45	40	35	30
Tensile strength (psi)	1,430	1,825	1,965	2,435	2,965	3,160	3,060
Compressive strength (psi)		3,000					
Ultimate elongation (%)	305	560	550	560	580	605	625

(*) Standard electrical grade. Additional properties of this grade are given in Table 2

NOTE: All grades are insoluble in all common solvents at temperatures below 50-60 deg. C. Soluble in chlorinated solvents, aliphatic hydrocarbons, and aromatic hydrocarbons at elevated temperatures.

COMPLETE PLASTICITY!

-MEGATHERM-*

CUTS MOLDING TIME 90%

▲ *The molded handset ready for ejection from the mold after the 30 second perfect cure.*

◀ *Megatherm heated preforms in press transfer chamber just before closing.*

Photos: Courtesy Shaw Insulator Co.

Federal Industrial Power Tubes, give power and performance to Megatherm and other industrial heating equipment.

Molding time on these telephone handsets was reduced from five minutes to 30 seconds with Megatherm.

In addition to rapid molding Megatherm provided a complete and uniform cure which was free of all internal stress.

Megatherm is doing plastic preform heating *better* and *more quickly* than any other method. In many cases Megatherm has made a plastic molding job possible which could not be done by other methods.

Megatherm units are compact, and may be easily moved from one production line to another. One of the four standard models will fit your production needs. Megatherm is available in 3 KW, 7 KW, 15 KW and 25 KW output capacities.

Cost of operation is low, the popular 3 KW Megatherm has a power cost of 5¢ per hour.

If you have a plastic preheating problem, now is the time to talk about it with Federal.

Federal Telephone and Radio Corporation

INDUSTRIAL ELECTRONICS DIVISION Newark 1, N. J.

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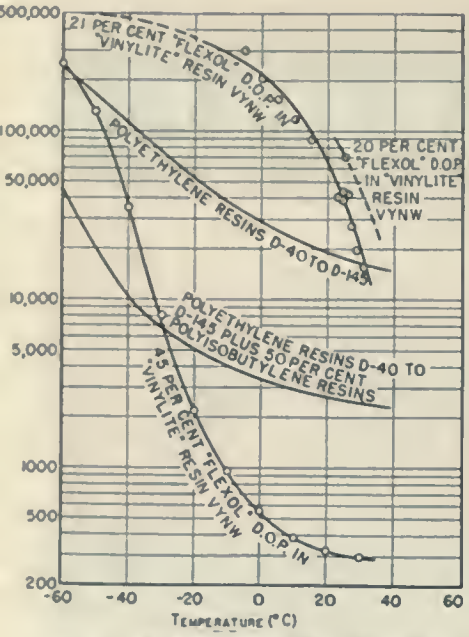


Fig. 4. Temperature-stiffness comparison of plasticized "Vinylite" resin VYNW and polyethylene resins (average)

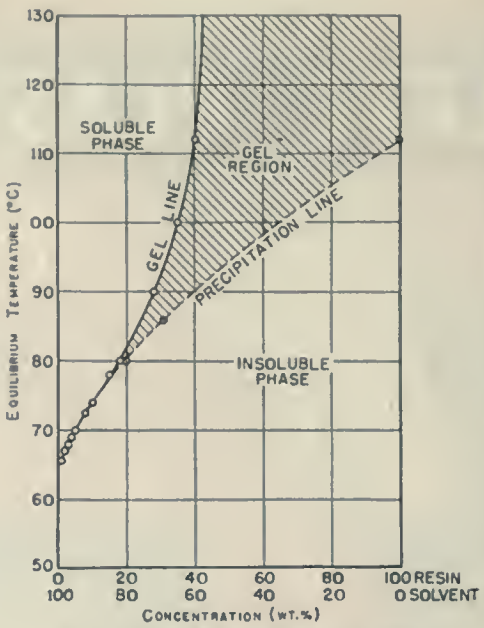


Fig. 5. Phase diagram for polyethylene resin-xylene system throughout range of concentrations, temperatures

of polyethylene resin now being made in quantity, DYNH, is designated as "D-55" to indicate that the Williams flow height of this resin is an average of 55 mils at 130° C.

None of the various solvents tested up to now will completely dissolve grade DYNH polyethylene resin at room temperature. At higher temperatures, resin DYNH is attacked and dissolved by a number of types of organic solvents to a varying degree. Table 3 lists a number of typical solvents and the temperature at which 1% of grade DYNH is in equilibrium with the solvent.

TABLE 2: Properties of Standard Electrical Grade Polyethylene Resin

Specific Heat: (18-40° C)	0.53
Heat of Combustion: (Cal gm^{-1})	11,100-15
Softening Temperature: (°C)	108-112
Moisture Diffusion Constant: (Mg hr^{-1} Cm^{-2} Mil^{-1} at 30° C)	0.028
Water Absorption: (% wt. gain, 24 hr at 25° C)	0.01
Thermal Conductivity: (Cal cm^{-1} Sec.$^{-1}$ °C.$^{-1}$)	
Range 0°-15° C.	0.81 x 10^{-8}
25°-40° C.	0.62 x 10^{-8}
Thermal Diffusivity: (Cm^{-2} Sec.$^{-1}$)	
0°-15° C.	1.66 x 10^{-8}
15°-25° C.	value changing
25°-40° C.	1.37 x 10^{-3}
Volatility: (% wt. loss, 72 hr at 82° C in air)	0.0
Thermal Expansion Characteristics: Cubical coefficient, °C^{-1} x 10^{6}	
—35° C.	300
—20° C.	410
0° C.	—
10° C.	550
20° C.	710
25° C.	745
40° C.	870
60° C.	1010
80° C.	1210
100° C.	1400
110° C.	1530
115° C.	750
115°-150° C.	750
150° C.	750
Power Factor: (25° C)	
1 mc.	30 x 10^{-4}
50 mc.	30 x 10^{-4}
Dielectric Constant: (25° C)	
1 mc.	2.3
50 mc.	2.29
Direct Current Resistivity: (25° C)	
Megohms-cm	>10^{9}
Surface Resistivity	
Ohms	2 x 10^{14}
Dielectric Strength: (V mil^{-1})	
20° C. 0.075" thickness	1000-1100
80° C.	630

Oxygenated solvents consisting of low molecular weight alcohols, ethers, ketones, etc., are poor solvents for polyethylene at elevated temperature. For similar reasons, the transmission of oxygenated solvents through polyethylene films at normal room temperature is negligible in comparison with more active solvents. This is borne out by the low water vapor transmission of DYNH polyethylene films.

The acid resistance of polyethylene at room temperature is very good. British literature references indicate that polyethylene, at room temperature, resists such reagents as hydrochloric and nitric acids and 50% caustic soda. At elevated temperatures the resin is unaffected by hydrochloric acid and 50% caustic soda but strongly oxidizing nitric and sulfuric acid attack the resin.

The saturated nature of polyethylene imparts a high resistance to ozone — much higher than that of rubber. A high resistance to atmospheric oxidation and weathering degradation at normal temperatures is an inherent property of DYNH polyethylene. A tendency to oxidize at elevated processing temperatures (above 100° C) is effectively inhibited by the incorporation of conventional rubber anti-oxidants in the polyethylene compound.

Standard plastics machinery is suitable for forming polyethylene plastics; and polyethylene film and sheeting

TABLE 3

Solvent	Equilibrium Temp. of 1% In Solution (°C)
Trichloroethylene—1, 2, 2	55
Carbon tetrachloride	59
Petroleum naphtha (Solvesso No. 2, Boiling Range 135-175° C)	65
Toluene	66
Xylene	66
Trichloroethane—1, 1, 2	82
Technical White Oil (Socony No. 208)	86

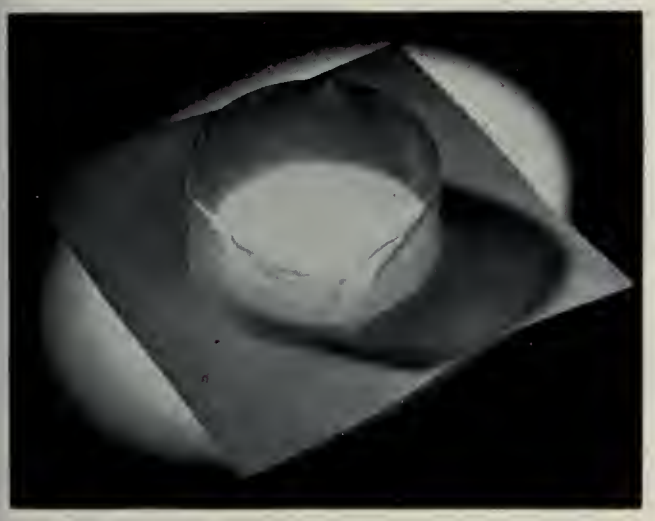
can be fabricated through the use of standard heat-sealing operations. However, the high softening point of the resins and the high coefficient of cubical expansion require changes in usual procedures for thermoplastics.

In both extruding and molding, it is necessary to design the die or the mold undersize so that the finished part will meet specifications. In addition, thick extruded sections require special cooling technique to avoid the formation of voids in the center of the section. In injection molding, press pressures will range from 9000 to 35,000 psi, cylinder temperatures from 270° to 375° F, and mold temperatures from 175° to 180° F.

After suitable compounding modification, polyethylene resin can be calendered under conditions that are normally applicable to vinyl chloride-acetate resin compounds (compound temperature 105° to 150° C). Relatively smooth sheeting can be calendered in thicknesses of 100 mils; and calendered films in thicknesses of 3 mils result in an attractive product, eminently suitable for wrapping foils. The resin compound can also be calendered onto many types of fabric to produce coated cloth. In all cases, the calendered surface may be planished or embossed in the conventional platen press. Because of the characteristic sharp softening point of polyethylene, some care is required in application of hydraulic loading and heating of the press to avoid extrusion of compound between plates. Sheets may be formed by blow-molding or swaging

Light and resistant, polyethylene makes an ideal insulation

Cable ends reveal various forms in which material is used



Boiling water does not affect this blow-molded container

Sheets given attractive embossed finish, using ordinary press

Possible Future Uses for Polyethylene

MEDICAL
- Sutures
- Cathaters
- Probing wire insulation
- Ampoules

MOLDED and EXTRUDED PRODUCTS
- Automobile hardware, steering wheels, etc.
- Knife handles
- Refrigerator trays and parts
- Hammer or mallet heads
- Business machine keys
- Canteens
- Glasses, dishes—light unbreakable picnic-ware
- Eye shades
- Flashlights (oil and impact-resistant type), cases
- Buttons, buckles, etc.
- Fish lures
- Wearing apparel accessories
- Children's toys (safe); blown and swaged articles
- Grommets
- Marine bearings—propeller shaft
- Connections for gas meters
- Dresser rings
- Extruded rings
- Extruded trim
- Collapsible tubes

FIBERS or MONOFILAMENTS
- Screens
- Filter cloth
- Spun fibers for fabrics

IMPREGNATED CLOTH
- Acid and solvent-resistant clothing
- Gloves for resistance to oils and corrosive agents
- Belting for use in contact with oils and solvents
- Conveyor belts in food and meat packing industry

LIGHTING
- Diffusing screens in fixtures, lamp shades, etc.
- Skylight windows
- Neon sign tubing
- Bus and train window shades

UNCLASSIFIED
- Casters and pulley facings
- Inert medium for standard colors (pigments, lakes and oil soluble dyes)
- Addition agents to beeswax, carnauba wax and other vegetable waxes
- Paper and cloth sizing
- Safety glass interlayer
- Shoe soles
- Shoe tipping
- Floor tile
- Addition agent to methacrylate resins for sound records
- Addition agent to bitumen and shellac for molded sound records
- Statuary and sculpturing material
- Printing plates

operations to produce containers that are form-stable in boiling water. These sheets may also be fabricated by heat sealing, although in this instance the abrupt softening of these resins between relatively narrow temperature intervals makes it necessary to use care in the selection of the method of sealing and the temperature to be used.

Thin films protected with glassine paper can be sealed with a hot iron without serious difficulty. Massive shapes of the resin may be welded by the use of a low flame from a gas welding torch. Strong and attractive welds are possible. The molten resin will not ignite if care is exercised in the manipulation of the flame. Cements involving resins and volatile solvents are unsuitable for cementing polyethylene.

Polyethylene can be machined, drilled, carved and milled by standard machine tools by the methods usually employed in shaping thermoplastic materials.

Sheets of polyethylene have a tendency to develop an objectionable static charge. Carbowax 1500, or aqueous solutions of Carbowax 4000 wiped on sheets and film with a damp cloth and briskly polished with a soft dry cloth, after the coating has dried, is effective in suppressing the static charge and produces an attractive high polish.

Polyethylene resins are insoluble in all organic solvents at normal room temperatures. However, in agreement

(*Continued on page* 100)

PLASTICS AT WORK

IN UTILITY SERVICE

Unlimited color range, strength and durability characterizes these light "Tenite" suitcase handles molded by Chicago Molded Products Co. Lengthwise handle halves are cemented quickly

This handy office gadget which not only removes staples but eliminates fingernail breakage as well is molded by Federal Tool Corporation. Made of shatterproof "Tenite"

Pocket-fitting Brownie Steel tape rules, such as these, do not dent or tarnish and are strong and durable. The case is "Tenite" molded by the Waterbury Button Company

Attractive pen sets such as these may be molded from many different plastics. A double or single unit is a useful desk accessory. Designed by Martial & Scull

PLASTICS AT WORK

IN PACKAGING

Invading forces find pliability and high tear strength in a vinyl base "Lumarith" covering, which does not prevent accurate shooting. This waterproof packaging is a product of the Celanese Celluloid Corporation

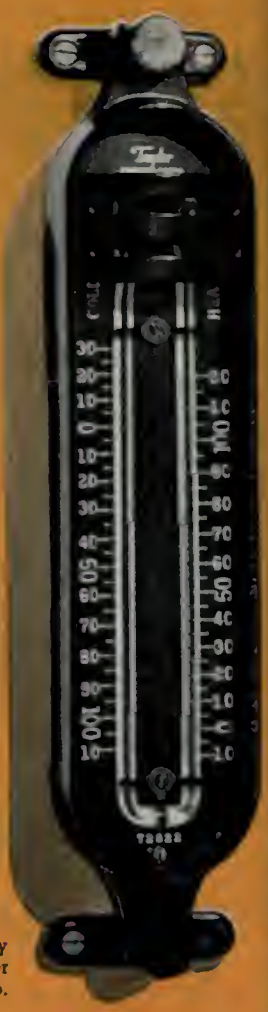
Vinylite resin coating heat-sealed cloth bag in new type corrugated cardboard box is made to avoid straining the seams and is stronger

These "Lumarith" plastic foil food bags, produced by The Transparent Products Company, offer protection against harmful and wasteful molds, germs and insect infestation

A United States Army toothbrush handle and box molded of "Tenite." Owens-Staple-Tied Brush Co.'s brush; box by Insel Co.

PLASTICS AT WORK
IN WEATHER CONTROL

"Velon" screen is used for insect screening and industrial purposes in filter plants. It does not rust or tarnish and can be made in a wide variety of colors. Firestone Tire & Rubber Company makes this product whose life is longer than that of metal

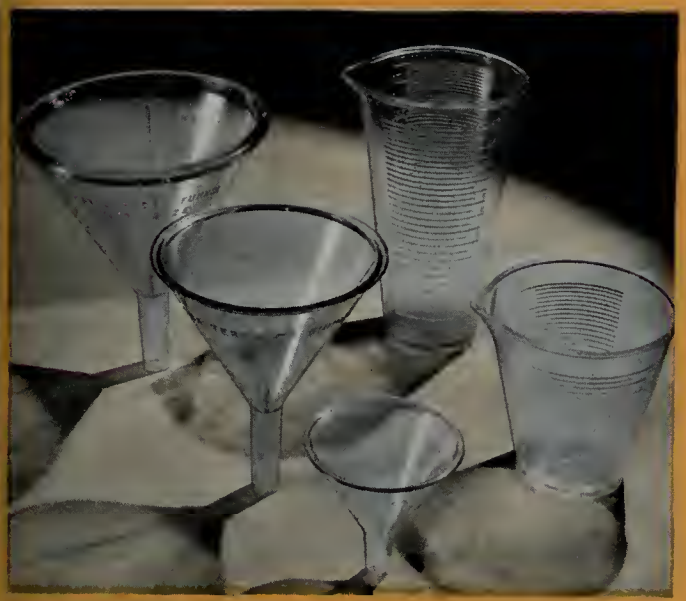


Tarnish and rust-proof, unaffected by any kind of weather, this Taylor Thermometer is molded by National Organ Supply Co.

Transparent, shatterproof "Tenite" rain gages measure rainfall for military operations. Molded by Dillon-Beck Mfg. Co., they will not dent while being shipped

The deleterious effects of tropical fungi, salt water and sunlight on the coverings of binoculars are no longer a problem when a vinylite made by Carbide & Carbon is used

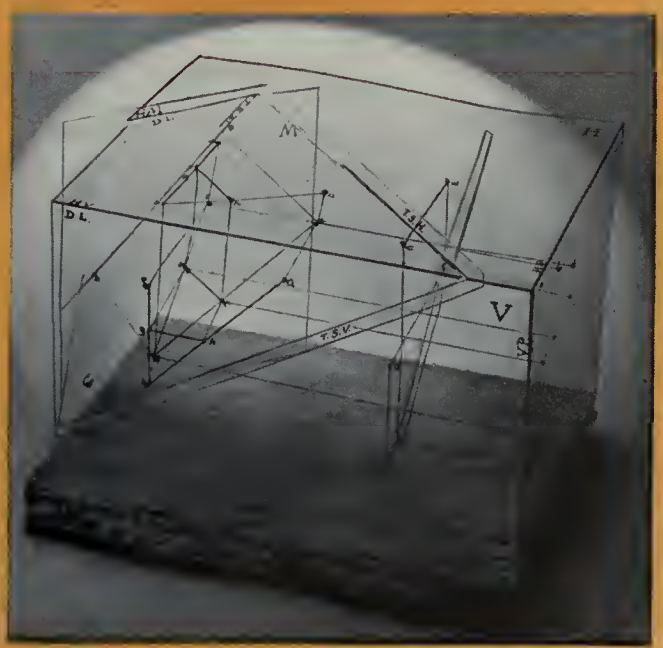
PLASTICS AT WORK
IN THE CLASSROOM



The use of "Lumarith" in the production of chemical funnels and graduates assures important accuracy. Injection molded markings remain clear. "Lumarith" product of Celanese Celluloid

Accuracy and less tendency to warp are characteristics of these cellulose acetate butyrate engineering scales, injection molded by American Molding. They are made of "Tenite"

This volume of the Encyclopaedia Britannica is bound with a plastics coated waterproof cloth called "Red Britannotex" which prolongs its life



To help clarify the teaching of descriptive geometry, the Cooper Union Art School, under the supervision of C. Dale Badgely has made up cellulose acetate models such as this

Phenolics in Electrical Connectors . . .

By Leslie Baird
Cannon Electric Development Co.

War Demands Producing Significant Improvements and Paving Way for Broader Applications in Peacetime

Lower half of this battery-type plug is made entirely of linen "Bakelite"

Four inserts, each with pin contacts, molded in multiple die

Pouring the powder to fabricate "Bakelite" cores for inserts

AN important opportunity for phenolics, long used in the electrical field, is in the manufacture of contact insulators and shells for certain types of electrical connectors. While full credit should be given the extensive work, design and research that has gone into their improvement, the greater and newer demands made on circuits, particularly in aircraft uses, necessitate more attention being paid to the phenolic insulator. The excellent electrical and mechanical properties of phenolics enhance their use for this purpose.

As aircraft, both military and commercial, are constantly seeking higher altitudes and with the development of the pressurized cabin, which enables those flying to acclimate themselves to such heights, electrical connections must be adapted to these new requirements. Extreme cold, encountered at high altitudes, makes plastics brittle and subject to breakage. Plastic insulators are not yet as effective as they should be at high altitudes since the flashover ratio increases with altitude from the sea-level base. Pressure-proof fittings are needed. Considerable development is now going on in these aspects of connector insulation, which is on the restricted list, because of war exigencies, and consequently cannot be told in detail.

New developments include efforts to coat plastic parts of connectors used in radio and aircraft equipment in tropical service. The combination of high temperature and humidity, plus dense vegetation, cause gases and acids to form. As a result, various fungus growths appear on equipment. It is often so rapid that after being subjected to these conditions for a short time the equipment is likely to be inoperative. There are literally thousands of types of fungi to combat and these problems are now under study. To offset the fungus attack, various methods of treating phenolic insulators are undergoing experimentation.

The first inserts designed for electrical connectors, developed in the early twenties by James H. Cannon of Cannon Electrical Development Co., Los Angeles, were made of laminated, fabricated phenolic. These provided excellent insulation for the early connectors. The fabricated type is machined, punched and drilled, being built from sheet stock. Fabricated inserts are generally made of three or more discs, each punched or drilled with different size holes to fit the contour of the socket or pin contact, thus locking the parts securely in place. Holes are first stamped into the fabricated insert discs and then drilled to accurate alignment. Simultaneously the contact identification on the fabricated face plate is numbered.

Molded plastic inserts came as a later development during the middle twenties with the designing of the *Type P*

NEW *Completely Automatic* CLOSURE PRESS

STOKES 50 ton Hydraulic Closure Press

- **HIGH PRODUCTION**
  Thousands of Caps Per Hour
- **FULLY AUTOMATIC**
  One man attends a battery of presses
- **COMPLETELY SELF-CONTAINED**
  Simple Installation
- **IDENTICAL PIECES**
  Uniform Split-Second Timing. Human errors eliminated

WANT threaded caps by the thousands per hour, at minimum cost?

This machine will make them, entirely automatically — feeding ball preforms into the multiple cavity mold, closing, curing, opening, unscrewing, ejecting and continuing the cycle without human attention. The machine requires only 7 seconds per cycle for all operations, exclusive of curing time. The time cycle is set to the split-second to make perfect caps every time. It can not vary, is independent of human error. One man can attend a battery of presses.

There are many other economies available in this press. For instance, controlled closing speed is accurately timed to the plasticizing action of the material. Surging and flashing are avoided.

A combination toggle-hydraulic action provides four-point support of the platen and assures parallel closing of molds — thus minimizing mold wear and assuring uniform parts requiring only tumbling for finishing.

Write for further details about this and other revolutionary Stokes Automatic Closure Presses being readied for post-war plastics production.

F. J. STOKES MACHINE CO.
6040 Tabor Road Philadelphia 20, Pa.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

Step in the procedure for numbering of fabricated insulators

connector for sound equipment. In this process, powdered phenolic is put under heat and pressure with die molds holding the pin contacts and molded insulators are produced. Since the socket contacts are full floating to insure perfect alignment, they cannot be molded in the insert disc itself. However, pin contacts may be fixed rigidly.

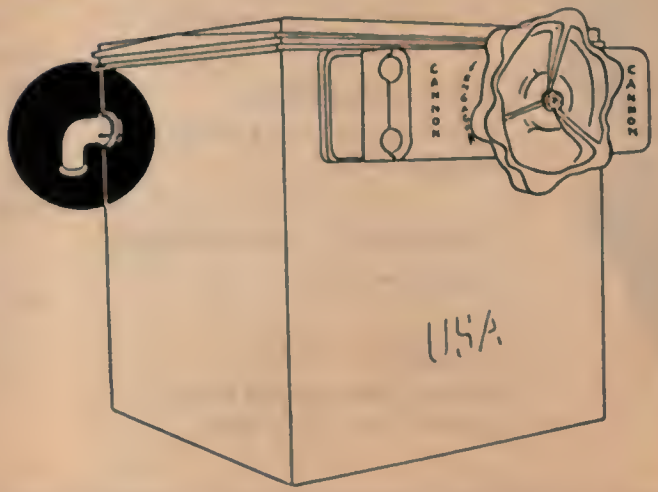
Bakelite and *Durez* are the most commonly used plastics in Cannon connectors, although *Melamine* is used in certain connectors for portable radio equipment where extreme moisture conditions demand high arc-resisting properties. *Polystyrene* is used on the *Type 14S-9(Y)* insert.

Black linen *Bakelite* has been used for certain receptacle insulation to withstand the wear of pins during polarizing action. A macerated phenolic is also used in plug shells for the battery connectors for engine starting.

Parts of Cannon's new quick battery disconnect are phenolic. Here the plug shell is phenolic and new designs of the handwheel will also be of phenolic instead of die-cast aluminum, a weight saving feature. A new battery vent recently designed to carry the tube from the battery emitting gases, is made of black polystyrene.

The insert insulation is one of the most vital parts of an electrical connector and the connectors represent the very nerve system of modern aircraft. END

Exploded view of quick-disconnect battery plug, showing handwheel, phenolic plug shell and accessory parts



Quick-disconnect battery recently produced by Cannon, featuring vent elbow of black polystyrene (shown above and circled in black at right), which carries tube emitting battery gases. Phenolic is used in plug shell; will replace aluminum in handwheel; has 8500 psi tensile strength, 0.16 ft-lb impact strength, 10,000 psi flexural strength

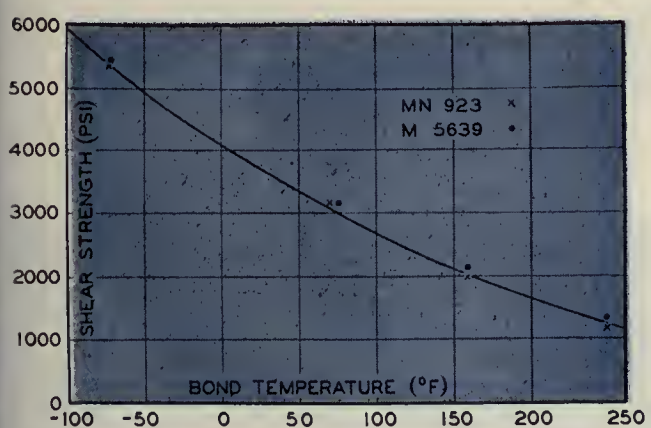
Two rivets formerly attached these plates to "Liberato r" assemblies. Now they are held by "Metlbond" tape

Plastic-Base Cements Alter Bonding Technique

By Dr. G. G. Havens and R. D. Ford

Design Staff Engineer and Assistant Group Engineer—Consolidated Vultee Aircraft Corp.

Promise Wide Post-War Use in Preventing Corrosion Between Dissimilar Metals, Joining of Varied Materials, Making Dies



Shear strength vs. temperature of typical "Metlbond"

THE discovery of new plastics and synthetic rubber materials in the last few years has served as a basis for new cements so strong that they have been successfully used for the bonding of metal-to-metal in aircraft production. In addition, they have found widespread application in the bonding of metal to non-metal and non-metal to non-metal.

An outstanding example of this may be found in the *Metlbonds* and the *Metlbonding* processes developed after extensive research by Consolidated Vultee Aircraft Corp.

A decade ago, the best adhesive capable of bonding various metals had shear strengths of only a few pounds for each sq in of overlap. Today, two pieces of metal can be so securely bonded together with the new *Metlbonds* that a pull of 1½ tons will not separate a 1 sq in overlapped joint.

Aeronautical research and the heavy production program for military planes has served to emphasize the need for adhesives. Engineers sought a method of fastening the skin and framework of an airplane to obtain smooth exterior surfaces, since significant reduction in the efficiency of an aircraft is caused by an uneven riveted surface. In all-metal plane construction, riveting and spot welding were the standard methods of attaching outside skins to the framework. Despite efforts to improve these methods, an exterior surface smooth enough to utilize the full efficiency of modern aerodynamic design could not be produced. The thin metal used for skins bulged between individual rivets or spot welds. This tendency could be prevented by the use

Dr. G. G. Hevens, who came to Consolideted Vultee Aircraft Corp. in 1942 as a design engineer specializing in the applicetion of new materiels to eircraft design, developed the "Metlbonds" and "Metlbonding" processes. He received his B.S. end M.S. degrees from the University of Ideho, his Ph.D. degree in the physics depertment of the University of Wisconsin; acquired several rubber patents.

After qreduetion from the University of Michigen, where he obtained his M.S. degree in chemistry, R. D. Ford taught chemistry for severel years before becoming employed in the rubber industry. For the pest 1½ years he has worked in the materials leboratory, Development Engineering Department, at Consolideted Vultee, where he hes been associated with Dr. Hevens in the "Metlbond" research work.

of a continuous bond, the goal of aerodynamic engineers.

The advantage of a continuous bond between two parts of a airplane is not limited to smoother skins and consequent improved airflow characteristics. *A continuous* Metlbonded *joint between two pieces of aluminum can be made stronger than a comparable riveted or spotwelded assembly. Metlbonding,* therefore, is not limited to nonstructural assemblies, but may be used for both secondary and primary structures in an airplane. The stiffness of *Metlbonded* assemblies has been shown to exceed those having intermittent type fasteners such as bolts, rivets and spot welds.

The *Metlbonding* procedure is so simple that unskilled employes can be trained to make acceptable assemblies in less than 1 week, compared to a much longer time necessary to train riveters and welders. The combination of lower labor training expenses and the fact that bonded assemblies can be made for a fraction of the cost of riveted ones results in a considerable savings in unit costs.

On rather limited applications thus far, use of *Metlbond* indicates savings of about 30% over riveting. One assembly which contains 14 nut plates attached to a 3" square aluminum piece required 20 min when assembled with rivets. The same assembly was *Metlbonded* in 5 min.

The *Metlbonds* also make possible the utilization of the full properties of such new materials as *Fiberglas,* which obviously cannot be welded or riveted. It increases the use of magnesium, which is subject to corrosion when placed in contact with other metals such as rivets.

The *Metlbonds* are not panaceas. It is not expected that they will entirely displace riveting or spot welding. The bonding of materials with adhesives has disadvantages under certain circumstances. A designer would not use spring steel where cast iron is required; similarly, he would not employ *Metlbonds* when rivets are indicated by the specific needs of an assembly.

Metlbond is not suitable for installations subjected to temperatures over 250° F, such as exhaust systems. In certain complex assemblies, where it would be difficult to apply pressure and heat, riveting or spotwelding would be more practical. Use of *Metlbond* would probably be limited in parts which require frequent repair because of the need for heating and pressure equipment.

Meets Structural Adhesives Needs

There are several requirements for a structural adhesive. The first, but not the most difficult to attain, is adequate shear strength. The cement must have sufficient flexibility to withstand impact loads. It must have resistance to heat and cold, aromatic solvents, and salt water. In addition, it must have resistance to aging and to fatigue.

Even fulfillment of these physical properties alone does not necessarily produce an adhesive suitable for industrial use. A cement with production applications must make joints not only superior in quality, but also less expensive than other methods of attachment.

Metlbonds meet all these considerations.

A number of different types of materials were used in experimenting with metal-to-metal adhesives. One of the

"Metlbonding" is used to join test wing bulkhead sections. Photo shows holes required if the sections were riveted together

first compounds tried was rubber hydrochloride which gave shear strengths too low for structural applications, particularly at —70° F. It also exhibited low resistance to aromatic solvents and salt water. Consistent bonds to Alclad aluminum alloys were difficult to obtain.

Numerous plastics have been considered as bonding cements. While some of these adhesives gave shear strengths as high as 6000 psi compared to 1800 psi for the average riveted construction, they were not suitable for the construction of aircraft because they were too brittle. In all cases the brittleness resulted in a concentration of strains which caused a progressive failure of the bonds even when loads much below the design strength of the joint were applied. The high shear strength reported could only be developed on specimens with very small overlaps and small bonded areas. Brittleness also caused poor impact and peel resistance, especially at low temperatures.

While brittleness is primarily a defect of the thermosetting plastic adhesives, the thermoplastic resin cements exhibit unsatisfactory characteristics due to softening. A considerable reduction in strength results at temperatures below those encountered by aircraft under operational conditions.

When some of the thermosetting resins were combined with synthetic rubbers, adhesives were obtained which exhibited none of the weaknesses of the simple plastics. They were found suitable for commercial use except that they required high curing pressures and rather expensive jigs.

In order to overcome the deficiencies of previous cements, Consolidated Vultee undertook the development of a synthetic rubber-plastic type cement. The objective was a product with satisfactory physical properties and sufficiently low curing pressures to obviate the use of expensive jigs.

Laboratory tests indicated that high curing pressures were required, not to give adhesion to the metal, but to cause the cement to flow sufficiently to provide uniform contact between the cement and metal.

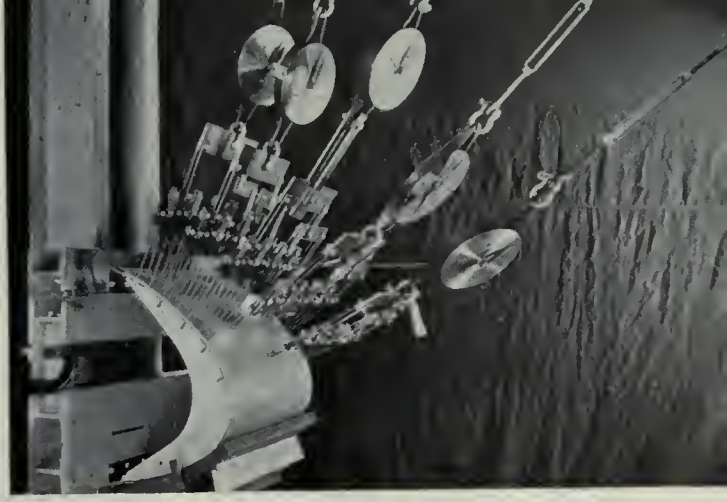
During the early part of the investigation, attempts were made to produce a single cement which would flow at low curing pressures and still retain the desired physical properties. An adhesive was produced which could be used at a curing pressure of 100 psi, half that required by other cements having equal physical properties. It was believed that a bonding material requiring curing pressures of only 25 psi or less would have to be developed before any considerable use could be made of adhesives in the production of aircraft.

The objective was reached in an adhesive process which employed a synthetic rubber and a plastic-base cement. The rubber base cement gives adhesion to the metal and flexibility to the bond. The plastic-base cement exhibits a viscosity during the cure sufficiently low to fill any inequalities in the surfaces of the materials being joined.

The impact and peel resistance of the combination was practically constant from —70° F to 160° F, indicating low frangibility. Shear strengths were sufficiently high over the same temperature range to meet aircraft design requirements.

In addition to having excellent physical properties, this process overcame the oft-repeated objection to earlier metal-to-metal adhesives which involved high tooling costs. More recently this two-component cement has been prepared in several forms for use in special applications, both by changing the method of application and by using the cement in conjunction with adhesives produced by other manufacturers.

These processes are known collectively as *Metlbonding*. Thus, the term *Metlbond* refers primarily to an adhesive process and not necessarily to any one component cement. Materials produced by other manufacturers will be used in conjunction with the existing *Metlbonds* whenever such use will result in an improved adhesive process.



Application of test loads to a leading-edge section of wing, the surface of which has been attached to ribs by "Metlbond"

Processes Now Available

At the present time the following *Metlbond* processes are available:

1. High pressure, high temperature, single phase, synthetic rubber-base cement, requiring 100 psi curing pressure at 330° F for 20 min. The adhesive is sprayed on parts to be bonded.

2. Low pressure, high temperature, two phase *Metlbond,* requiring 15 psi curing pressure at 330° F for 20 min. The synthetic rubber component is sprayed and a plastic component brushed on parts to be bonded.

3. Two types of tape, one requiring 250° F curing temperature, and the other 330° F curing temperature. Both types require a curing pressure of 100 psi. The high temperature type has the highest shear strength and best heat resistance. The low temperature type can be used where the parts contain fiber inserts or other organics unstable at 330° F.

4. A very low pressure, high temperature *Metlbond,* requiring a curing pressure of 1 psi and a curing temperature of 330° F. The shear strength of this type is approximately two-thirds that of the first two types.

While the *Metlbonds* were developed primarily for aluminum alloys, experience has shown that a wide variety of solids can be bonded successfully. These materials include

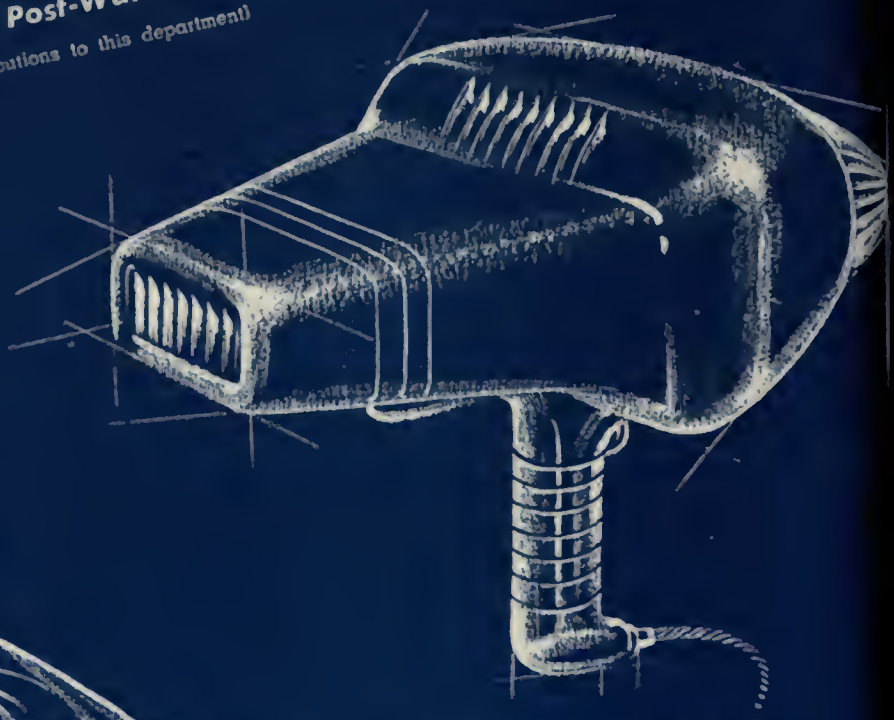
(*Continued on page* 96)

"Metlbonded" specimen placed in a curing press. The platens are electrically heated and pressure applied to complete the bond

ON THE DRAFTING BOARD

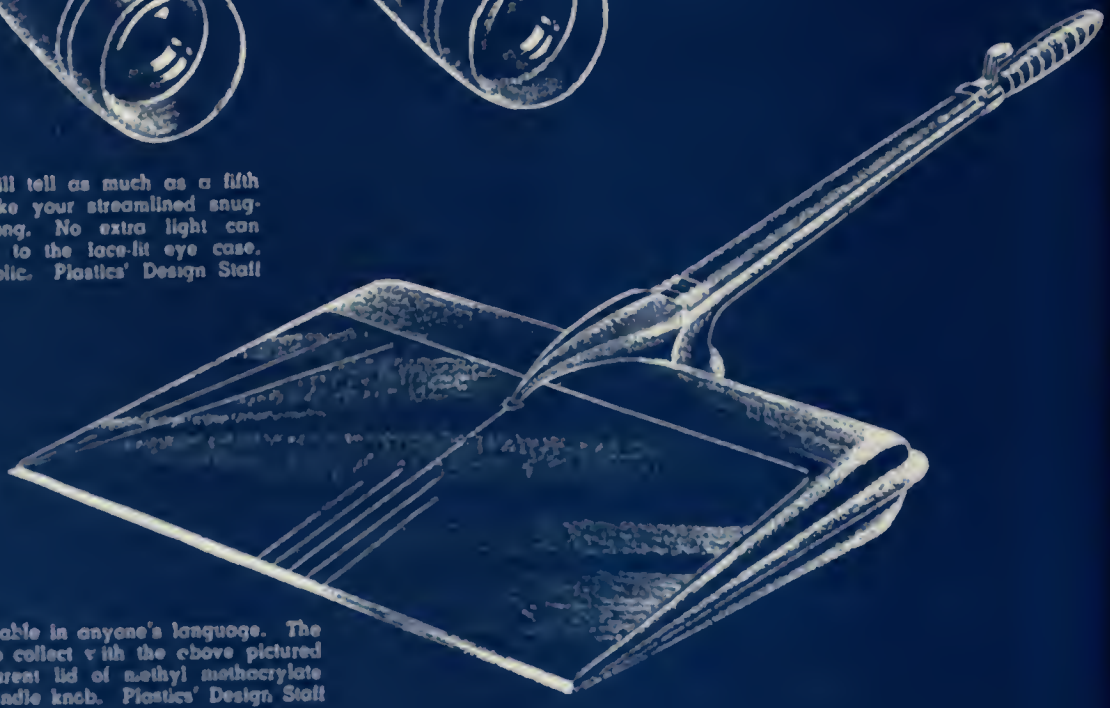
Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

(PLASTICS welcomes designers' contributions to this department)



Time consumed in drying hair in the ordinary manner is greatly reduced with this portable electric hair dryer. It is housed in a molded cellulose-butyrate acetate cover. The heat control knob forms part of the design. Plastics' Design Staff

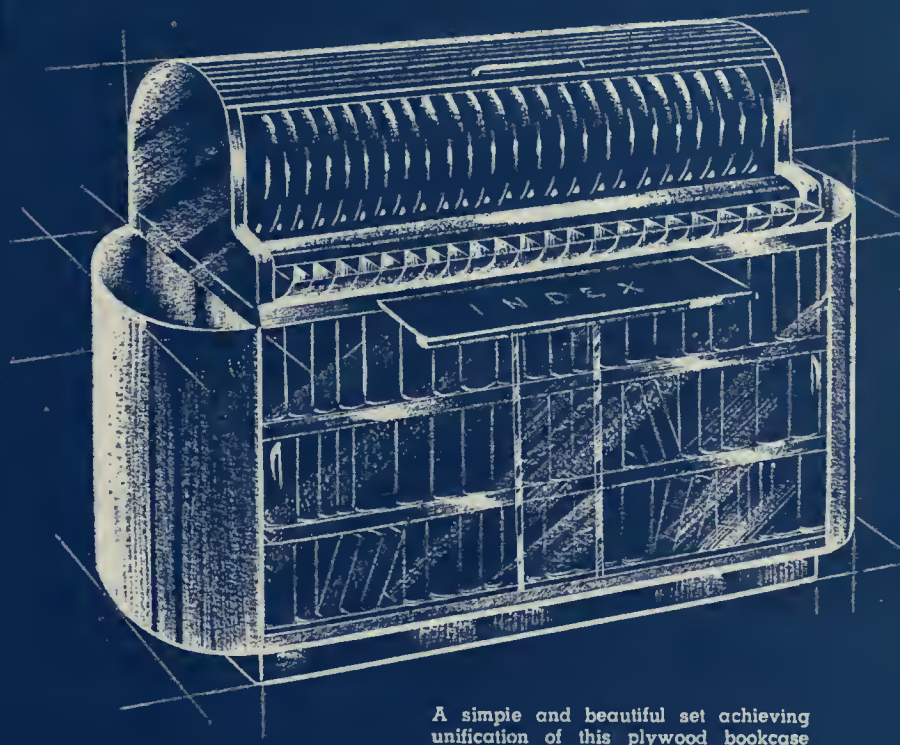
Your balcony seat will tell as much as a fifth row center if you take your streamlined snug-fitting binoculars along. No extra light can hinder the view due to the face-fit eye case. The body is a phenolic. Plastics' Design Staff



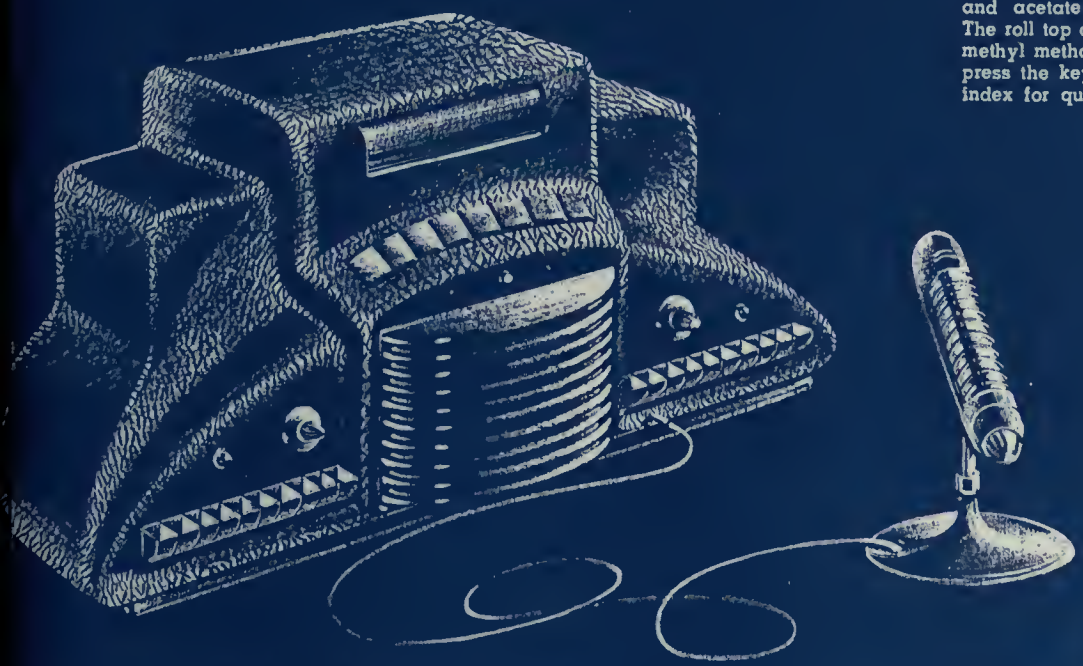
Housework is unavoidable in anyone's language. The dust will be easier to collect with the above pictured dustpan. The transparent lid of methyl methacrylate opens by pressing handle knob. Plastics' Design Staff

Drawings by Julian Krupa,
Plastics' Art Department

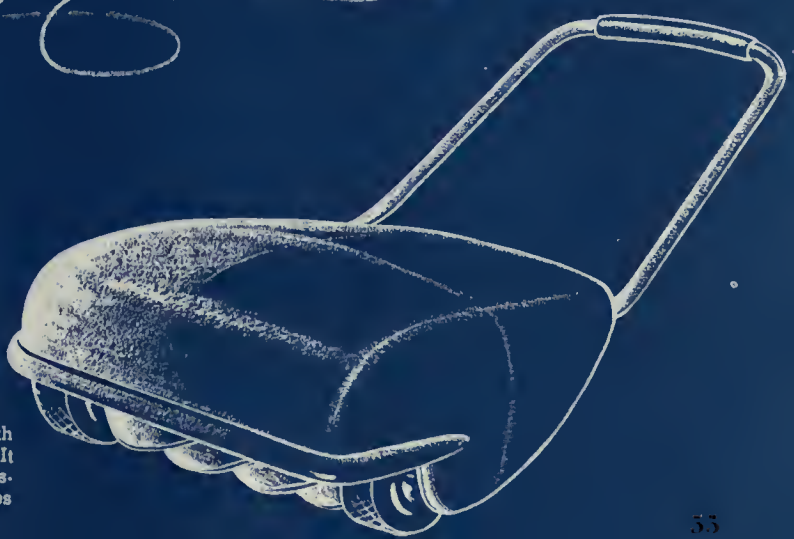
A double row of teeth plus corrugation adds to the combing surface of this comb. It may be molded with smaller or larger teeth than the one shown here. Cleaning is facilitated by spaces between the teeth and at the base of teeth. By Eileen Gatechair, Institute of Design



A simple and beautiful set achieving unification of this plywood bookcase and acetate film roll record cabinet. The roll top and keys are molded out of methyl methacrylate. You need only to press the key and roll is released. An index for quick location. Julian Krupa



Simplicity in lines is gracefully attained in the above cabinet for an acetate film roll recorder. It is produced from plastic-bonded plywood. The housing and stand of the attached microphone are made out of plastics, protecting the mechanism. By Julian Krupa



Save yourself unnecessary gardening backaches with this light, easily operated, compact lawn mower. It folds up, thus decreasing storage room demands. Housing is made of plastics. By C. E. Waltman & Associates

Radiograph of thermostatic control switch encased in a plastic housing. The unit can be watched in operation with fluoroscopy

Molders Cut Rejects With X-RAY

By J. P. Nielsen

Research Physicist
North American Philips Co., Inc.

Rising Standards Which Accompany Expansion of Plastics in Industry Demand Careful Product Inspection

OF ALL the materials used in industry, plastics are the most easily penetrated by X-ray. Thus, the plastics industry has at its disposal an effective means for the examination and inspection of the internal condition of its products.

As plastics are more and more finding their way into engineering applications, where requirements demand the best that a plastic material has to offer, it is becoming increasingly important that any irregularities occurring within the material or product are kept to a minimum. Porosity and other internal void conditions which impair strength and electrical properties, misalignment of metal inserts, defective assemblies sealed in plastic cases, are kept to a minimum by sound inspection methods followed by proper corrective measures. Such inspection problems can be handled in various ways, and X-rays in many cases can offer the quickest and most satisfactory solution.

Fluoroscopy and Radiography

Because of the ease of X-ray penetration in plastics many inspections can be made fluoroscopically. This consists simply of viewing an X-ray shadow of the product on a fluorescent screen. Fluoroscopy does not give fine detail but it may nevertheless give the desired information, in which case a rapid, inexpensive and non-destructive inspection is made. Special fluoroscopes have been designed for the plastic industry for operation by plant personnel, in which the usual hazards of X-ray exposure and high tension are eliminated. All that is required to make an inspection is to place the object in the cabinet—

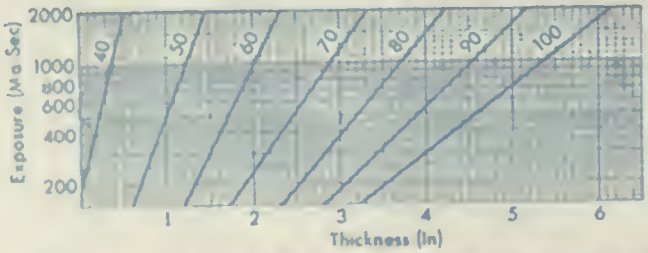


Fig. 1. X-ray technique chart. Type "A" plastics using "Searchray" model 150; 30" focal-film distance; density, 1; "M" film

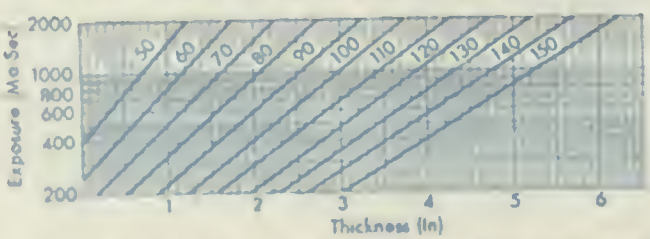


Fig. 2. X-ray technique chart. Type "B" plastics using "Searchray" machine model 150; 30" F-F distance; density, 1; "M" film

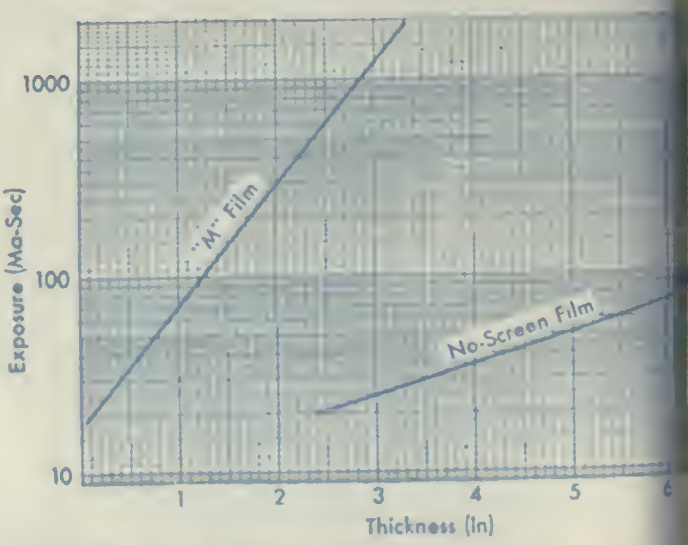
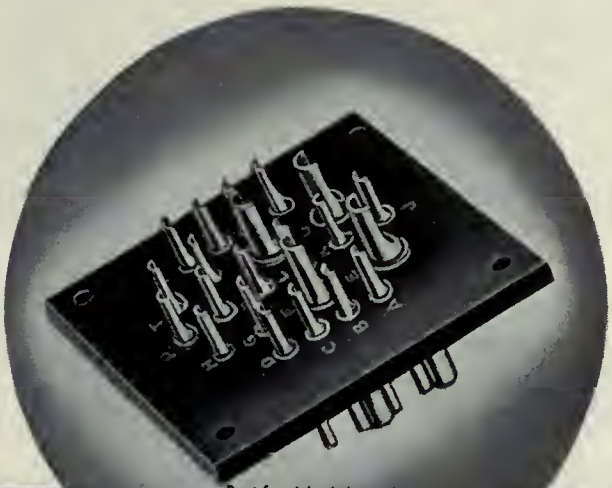


Fig. 3. X-ray technique chart for Type "A" plastics when u the Model 80 "Searchray" machine; kvp fixed at 80; densi

22 METAL INSERTS

..COLLATED

..POSITIONED



Part furnished through the courtesy of Kellogg Switchboard and Supply Company, Chicago.

AND MOLDED IN PLACE!

The required part, a special plug, presented very difficult molding problems . . . the prong inserts had to project out from both sides of the plastic plaque . . . their silver plated surfaces had to be kept free from flash . . . and each of the 22 prongs had to face in the same direction. Consolidated's solution to the problem was to hold to close tolerance the section of the mold into which the inserts fitted—to hand position the inserts and to transfer mold using a brown, general-purpose Phenolic plastic.

This Consolidated achievement is reviewed for the benefit of manufacturers faced with molding difficult insert assemblies. Our know-how works to your advantage. Contact our home office—or nearest branch.

Consolidated MOLDED PRODUCTS *Corporation*
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CMP

Fig. 4. Top, Type "A" plastics, characterized by low X-ray absorption, taken with 40 kvp, 5 ma, 90 sec. Bottom, Type "B" materials, showing high absorption, using 50 kvp, 5 ma, 90 sec. All specimens used in both rows were ¼" thick

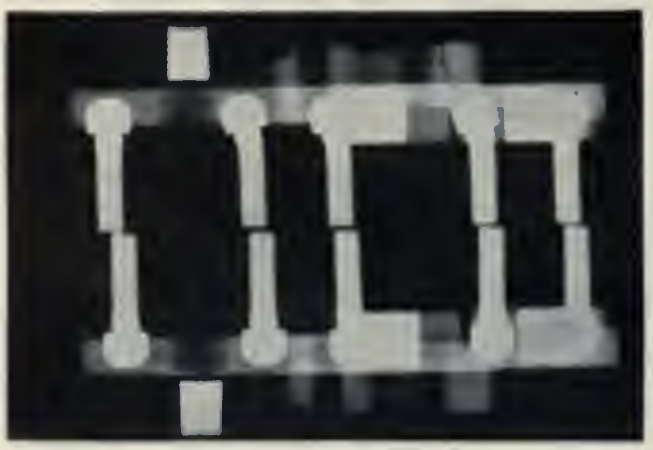

Fig. 5. In the photo above, fluoroscopy reveals how apparently sturdy inserts may become bent in the processes of production. At the bottom, inspection shows a case of severe displacement of electric wire in a molded item. X-ray is preferable to an electrical breakdown test, which often affects the plastic, making it more susceptible to failures at lower voltages

press a button—and the X-ray image appears on the screen.

An 80 kvp *Searchray* unit has been developed by North American Philips Co., Inc., in which plastics up to 1" thick can he viewed readily on the screen. The kilovoltage of the unit designates its penetrating power. Conveyor type units allow inspection at a more rapid rate.

Fluoroscopy is very much dependent on the operator as the eye acuity varies considerably between individuals. Also, for the finer work, he must condition his eyes to low illumination by wearing certain type goggles, or staying in a darkened room for several minutes before viewing the fluorescent screen. With proper conditioning, a plastics thickness up to three inches can be inspected with the 80 kvp unit.

In the inspection of thick objects and in work involving fine detail, radiography is generally used. Radiography is the recording of the X-ray image on film or sensitized paper, which can be closely studied at leisure. The 80 kvp fluoroscope unit can be used for this technique as the procedure is comparatively simple. A cassette or film holder is placed in a position approximating the fluorescent screen and an exposure usually of several seconds' duration is made by turning on the X-rays. No focusing is necessary, the exposure time and the type film being the only variables. The radiograph is always equal to or greater in size than the object, depending upon the distance of the film from the object.

A 150 kvp *Searchray* unit has been developed by North American Philips that can radiograph from 1/16" to 15" thickness of Type "A" plastic (See top of Fig. 4). This larger unit has greater versatility in radiographing objects with sections of different thicknesses, and also it will take larger films than the smaller unit. Its kilovoltage can be varied through the range from 28 to 150, which gives it the capacity to handle a variety of materials and a variety of thicknesses. This unit as well as the 80 kvp unit are entirely self-contained and ray-proof.

In order to obtain optimum results in a radiograph, technique charts are useful. These give the exposure nec-

What is "PINKO"?

From the laboratories of Hummel-Ross come "Pinko" and "Pink-O-Perf," papers which are proving ideally suited to plastic impregnation and plastic laminates.

"Pinko," available in 5 degrees of absorbency and in calipers from .006 to .050, has characteristics that make it outstanding for plastic lamination.

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HOPEWELL, VA., U. S. A.

Fig. 6. Typical void condition revealed by radiograph in end view of brass sleeve insert. Note periphery

essary for a given thickness of material. Although all plastics are not equally transparent to X-rays, they fall into two categories. Radiographs of four low X-ray absorption plastics are shown in the upper group in Fig. 4, and for convenient reference this category is designated as Type "A." It can be seen that polystyrene is the most transparent in the group, i.e., it shows the least X-ray absorption as indicated by the darkened film, while phenol appears to be least transparent. To the radiographer the differences within the group are not great and one technique chart can serve all four materials.

X-ray Absorption

X-ray absorption is a function of the average atomic weight of the substance penetrated. Plastics, being made up of such elements as carbon, hydrogen, oxygen, etc., have a low average atomic weight, and therefore are a low X-ray absorption material. The particularly low X-ray absorption of polystyrene is explained by the fact that it is a hydrocarbon, while phenol and urea are compounds containing carbon, hydrogen and oxygen, and the relatively heavy oxygen raises their average atomic weight substantially.

Some plastics such as vinyl chlorides and styrenes contain chlorine in their compound structure. This results in a considerable jump in the X-ray absorptivity as is shown in the lower group of Fig. 4 where a higher kilovoltage was necessary to obtain an equivalent density in the film. Plastics falling in this group for convenient reference are referred to as Type "B." Their X-ray absorption compares with that of ceramics and the light metals as the relative densities in the radiograph show.

Figures 1 and 2 show technique charts for the Type "B" and Type "A" plastics, respectively. The charts indicate the milliampere seconds exposure and the suitable kilovoltages necessary for different thicknesses of material to give a density of 1 on the film, based on the Hurter and Driffield scale. Where a chart indicates that two or more kilovoltages may be used for the same thickness, the lowest kilovoltage will give the most contrast in the radiograph. A fine grain film is recommended which, because of its slowness, permits the X-raying of plastics down to ⅛" thick. Where fillers are used in the plastic body, the X-ray absorption is somewhat different; however, the charts will give the approximate technique.

As can be seen in Figs. 1 and 2, large changes in thickness require different kilovoltages. However, where the kilovoltage is fixed, as in the 80 kvp *Searchray* unit described above, various thicknesses can be radiographed by changing the type of film. Fig. 3 is a technique chart for this unit. "M" film is indicated for thin plastics, while No-screen film (Eastman) is indicated for thick sections. No-screen film responds quickly to the weak radiation which comes through a relatively thick piece. Thus, by proper selection of film, a fixed 80 kvp unit can be used to radiograph from ⅛" to several inches of plastic, and thus circumvent the need of the more expensive variable units.

Applications

A survey of actual applications of X-ray units in the industry revealed that most are used by molders, and are used in three types of inspection, classified as follows:

1. Checking assemblies encased in plastic housings.
2. Checking metal inserts.
3. Investigating internal voids.

The first inspection method, that of checking an intricate assembly in a plastic case, has proved of considerable value in some plants. In one instance, several hundred switches were assembled with part of the assembly missing. These were mixed with several thousand that were properly assembled. To reopen and inspect every switch would have been prohibitive. However, a fluoroscopic inspection of several pieces at a time enabled quick recovery of all misassembled pieces. Sometimes working parts cannot be viewed properly when the case enclosing the parts is open, but such an inspection may be possible either fluoroscopically or radiographically. The photo on page 56 shows a thermostatic control switch which did not operate properly. By viewing its operation under the fluoroscope, the cause of the trouble was quickly detected.

Checking of metal inserts for alignment is the most common application, and is generally a fluoroscopic inspection. Fig. 5 shows two examples in which inserts were displaced or bent. For small items, lots of a hundred or more can be inspected in one fluoroscopic view. The

Fig. 7. Too-rapid curing or case-hardening illustrated by enlargement of radiograph of a molded phenolic item

radiograph at the top of Fig. 5 shows considerable bending in the inserts although they appear to be of quite sturdy stock. At the bottom is a molded item in which an electrical wire is severely displaced. Electrical breakdown tests for such wires are not always advisable as sometimes the plastic is affected, making it susceptible to electric failures at lower voltages.

Some molders inspect their products for voids in the

(*Continued on page 99*)

ANOTHER TOUGH MOLDING PROBLEM SOLVED . . . . .

PHOTO COURTESY ELECTRO-VOICE MICROPHONES

Out of a wide range of tough molding assignments relating to war work, the little earphone of this Signal Corps outfit was one that required more than usual study by the Imperial Molded Products engineering department.

This molding job was a very delicate one as it was necessary to hold the diaphragm position within + or — .001 inch. The molding was further complicated by undercuts and the use of side cores. Very fine threads—40 to the inch—had to be molded on the body and cover.

The successful solution of this earphone molding job on a practical commercial basis is one more indication of the technical service that is available to you through the Imperial Molded organization. If you require a molding service organized to handle tough assignments, as well as the ordinary run of molding work, we shall be pleased to work with you—subject, of course, to present day limitations imposed by war work.

IMPERIAL MOLDED PRODUCTS CORP., 2924 W. Harrison St., Chicago 12, Ill.

● The plastic parts for the earphone shown here in actual size were produced for the Signal Corps under a sub-contract. This earphone was purposely made extremely small so that a gas mask can readily be used over it.

The new earphone actually gives better reception than the older types. It carries all the vibrations to the ear and excludes outside noise to a large extent, because it fits right into the ear.

BULLETIN K-200 will give you many interesting details about Imperial Custom Plastic Molding. **Your request will bring a copy.**

IMPERIAL Plastic Molding

BAKELITE ★ PLASKON ★ MAKALOT
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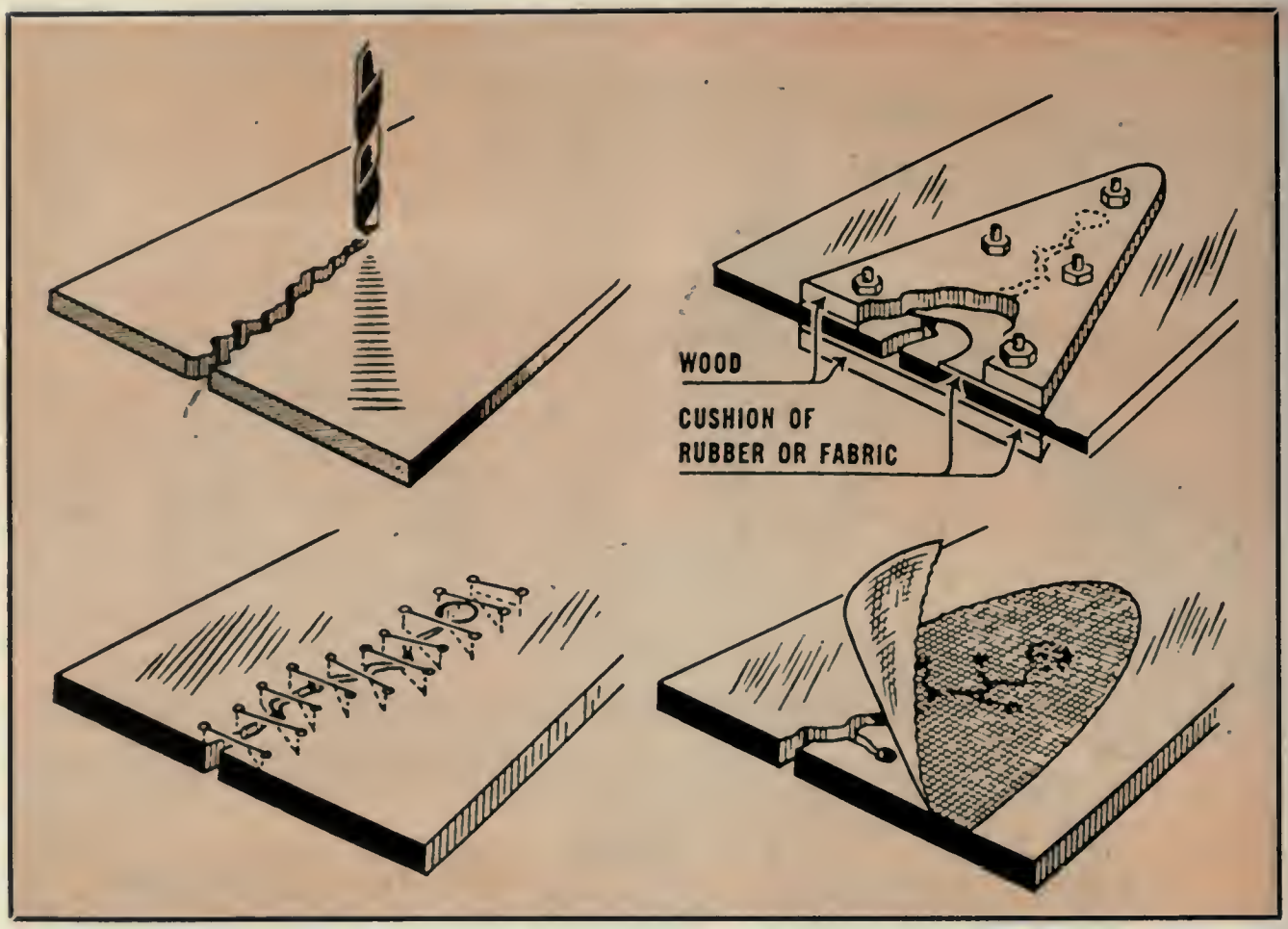


Emergency repairs: Left to right (top), drilling the end of a crack to relieve the strain; after drilling, reinforcement with wood; (bottom), soft wire lacing; cementing a fabric patch

Repair and Maintenance of Methacrylates

By Henry O. Belleville
E. I. duPont de Nemours & Co.

Experience Gained on Aircraft in Wartime Provides Guide for Procedure in Wide Range of Applications

WARTIME maintenance of methyl methacrylate resin used for transparent aircraft enclosures has developed many techniques which will be adaptable to the servicing of post-war private and commercial planes. These will be just as important for commercial peacetime operations as they are today on the battle fronts.

The first step in maintenance of methacrylate enclosures is a thorough cleansing. Both inside and outside surfaces are flushed with liberal quantities of clean water.

A light flushing follows, with a soft cloth or sponge dipped in grit-free, lukewarm water. Frequent rinsing of the cloth or sponge to remove grit is important. Any spots of oil or grease remaining on the enclosure after this flushing may be removed with hexane or methanol. These are applied with absorbent cotton or a soft cloth such as Canton or Domet flannel.

A final flushing with plenty of clear water completes the cleansing, which is repeated whenever deposits begin to obscure visibility. Under severe conditions, cleansing daily or more often may be required. Abrasive cleaners or compounds containing any hard mineral material should be avoided since they may scratch the surface of the methacrylate.

When light scratches mar the surface and impair visibility, clarity may be restored to the cleaned, dried surfaces by simple hand-polishing with *Noxon, Ken-Glo, Auto-*

Acrylic shavings, ethylene dichloride make crack patch cement

Strains of bullet-hole radiating cracks relieved by drilling

Groom, Lincoln M-3828, McAleer's Airplane Polish, Du Pont Polish and Cleaner, Wilco Scratch Remover, Franklin's Triple Life Cleaner, Duco No. 7 Cleaner, Simoniz Liquid Cleaner. These should be applied with absorbent cotton and very light polishing pressures should be used.

A high polish may be obtained and the surface protected by waxing with such materials as *Duco No. 7 Wax, Permaseal, Simoniz, Johnson's Wax,* or *Franklin's Triple Life Paint Protector and Triple Life Wax.* These should be rubbed to a high gloss with absorbent cotton.

Power-driven buffing wheels may also be used for polishing. The wheel must be buffed only lightly over the surface and kept constantly in motion to avoid overheating of the plastic. A hard-type buffer with closely spaced muslin disc is used first, followed by a soft-type buffer with discs of flannel or muslin which are separated by one or more spacers to give an open construction, or other light fabric. *Plascor* and Hanson-Van Winkle-Munning *4M-30* or others of the finer grades of compounds are satisfactory buffing agents.

Treating Scratches

More serious scratches require treatment with waterproof sandpaper. The sandpaper is first thoroughly wetted and then wrapped around a felt pad or wooden block. The coarseness of the paper to be used is determined by the depth of the damage, though grades coarser than 320 should never be used.

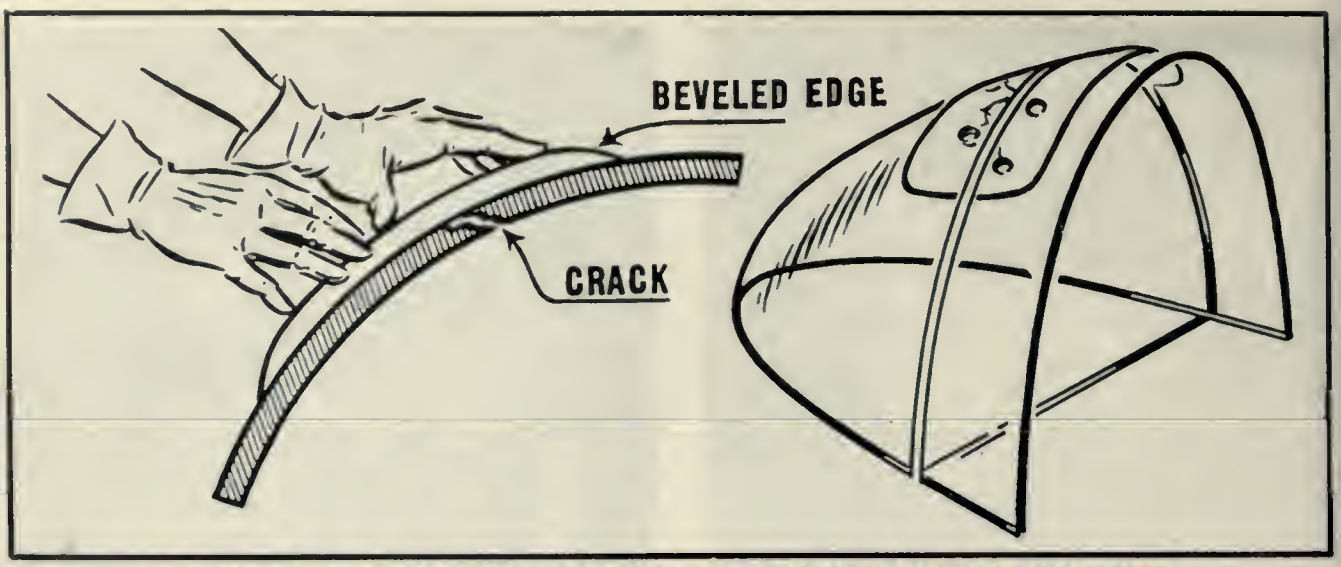
The area surrounding the scratch is first sanded with the coarsest paper lubricated with water or soap solution to lower surrounding surface to the depth of the scar. A finer grade is next applied to remove all trace of scratches left by the first sanding. Successively finer grades are then used until only slight abrasions from the finest grade of sandpaper remain. Surfaces should be thoroughly cleaned between each sanding. Afterwards, the entire sanded area is buffed and then polished with wax to complete the removal of the scratches.

Repair of cracks is another important operation. When a crack develops, any force acting upon the panel tends to concentrate its effect at the apex of the fissure and extend its length. But if a hole is drilled at the very end of the crack, it diverts the force around itself and the crack does not spread.

Therefore, as the first step in a repair job, a hole ⅛" to 1/16" diam. is drilled at the apex of each crack. Pressure

Bullet hole patched by large section cut from acrylic sheet

Mounts must allow for metal-plastic differences in expansion



Curved surfaces repaired by forming heated patch to contour and holding in place with weight or clamp

on the drill must be gentle to avoid chipping the material when it breaks through.

A patch is next applied over the crack and its surrounding area. It may be cut with any suitable saw from a sheet of acrylic plastic. The entire panel, except for the area to be occupied by the patch, is masked with cellophane or tape resistant to cement.

Cements that may be used include monomeric methyl methacrylate or acrylic plastic chips or shavings may be dissolved in ethylene dichloride and spread on the patch. In an emergency acetic acid may also be used as a solvent for the chips and in this case the operator should wear rubber gloves for protection.

When factory cement is used, one side of the patch is masked and dropped into the cement, with the unmasked side down. After it has soaked until the surface has softened, the patch is applied to the panel. It is moved about to seat it properly on the panel and to force out all air bubbles. It is pressed down evenly and held in place under light pressure for at least 4 hr. This cementing is similar in effect to a welding operation, for the cement softens and dissolves the two pieces to be joined, the cement and softened acrylic fusing, and finally hardening.

Permanent repairs can be made by cutting out the damaged area and cementing a plug of methacrylate into the opening. Fractured sections away from edges are removed by making a circular cut around the damaged area with a hole saw or other equipment. The edges of the opening are then tapered evenly by filing or sanding and a "plug" of methacrylate is cut to fit. The material used for the plug should be thicker than that used for the enclosure, so that the plug can be sanded to exact contour after cementing. The plug edges should be tapered to a slightly steeper angle than the edge of the opening. The plug is then heated until soft and is formed to the shape of the opening by pressing it firmly in place and allowing it to cool. The plug is then removed, its edges softened by soaking in cement, and is replaced in the opening and held firmly by a weight, clamp or other means.

In repairing cracks in curved panels, the patch must first be warmed until it is soft enough to be shaped to the contour of the panel. It may then be formed by pressure upon the cracked area. When cool, the patch may be applied as on flat surface, but after cementing it must be held in place by a weight or jig of the same contour until the cement sets.

A panel split in two pieces by a crack may be temporarily laced together with cord or soft wire, threaded through holes drilled in the plastic on each side, about ½" in from the edge of the crack and about ¾" apart.

Maintenance frequently requires that panels be removed from enclosures for replacement installation. Panels may be mounted in any one of the common types of channels, including a single extruded channel, mounting between a metal frame and a rubber molding, or flush installed with rib reinforcements.

Certain basic precautions apply in any type of mounting. Changes resulting from contraction and expansion must be anticipated. Rising temperatures expand the methacrylate and the metal mounting at different rates, the plastic sometimes expanding two to three times as much as the metal. Unless sufficient space is provided in mounting, varying temperatures may cause the panel to crack the frame. Sudden drops in temperature, conversely, have the opposite effect—shrinkage of the acrylic panel may cause it to fall from its mounting unless sufficient channel depth is provided.

For the same reason, installations requiring bolts must provide holes for these fastenings of sufficient oversize to avoid development of excessive stresses at the joints in changing temperatures. Bolts should not be tightened excessively. A good rule is to tighten the bolt with moderate hand pressure, then turn each nut back slightly. Shoulders or spacers should be used wherever possible in bolting to avoid undue direct pressure on the plastic material itself.

In mounting all acrylic installations, only light hand pressure should be used to make a panel fit. Forcing should never be attempted. If a panel does not slip easily into the channeling, it should be replaced by another, or formed to correct size and shaped to fit.

The best method of mounting enclosure panels of methacrylate is in an extruded metal channel frame with a minimum insertion depth of ⅜" and a width sufficient to provide clearance for a packing strip of neoprene or neoprene-cork composition of at least 1/16" thickness on both sides of the plastic sheet. The mouth of the channel should have rounded inner edges to prevent concentration of stress at that point.

Plastics have many advantages for aircraft applications, particularly light weight, ease of fabrication and ability to lend themselves to repair procedure; but they lack the surface hardness of glass, and are easily scratched with resulting impairment of vision. END

Plastic Siphon Tubes For Irrigation

By L. F. Larsen
Extension Agricultural Engineer
University of Nebraska

Light Weight and Labor-Saving Qualities Create Possibility for Widespread Use in Farming

DRASTIC reduction in the amount of labor needed for irrigating row crops has been accomplished by Nebraska farmers through the use of plastic siphon tubes.

A few years ago, several farmers who were faced with a severe labor shortage, conceived the idea of conducting water from filled laterals into the rows of crops by means of siphon tubes, rather than with lath boxes, which were formerly used.

The rate of flow can be controlled very easily by moving the siphon tube so as to raise or lower the discharge end. Trash floating on the surface of the water does not give as much trouble in the clogging of siphon tubes as it does in the case of lath boxes, since the water enters the tube below the surface.

Plastics Replace Metals

At first, metal conduit pipes were used for the siphon tubes, but metal soon became scarce under wartime conditions. It was then that Philip Eshelman, former extension agricultural engineer at the University of Nebraska, investigated the possibility of using plastic siphon tubes. These, he found, were not only just as satisfactory in performance, but also had the added advantage of being lighter in weight, so they could more easily be carried from place to place on the farm.

This season, there has been a great demand for plastic siphon tubes. Manufacturers, due to wartime conditions, however, have been unable to cut and bend these tubes properly for the farmers. The latter experienced difficulty in obtaining the tubes in small quantities, and also in having them cut and bent to suit their individual needs.

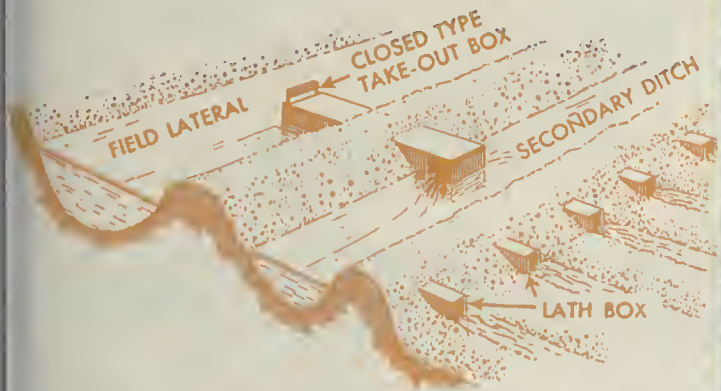


Fig. 1. Closed type take-out and lath boxes, formerly used for irrigation, demanded strenuous "mudding in"

Fig. 2. Modern method of irrigating row crops by means of plastic siphon tubes, easily moved from place to place

Fig. 3. Depression in ditch bank was necessitated by use of short tubes. Average conditions require 4 ft length

Ftg. 4. To bend tubing, sand is poured into it and the ends are corked to keep tube from losing shape when heated

Ftg. 5. Second step in bending is to place tube, with sand securely corked, into water heated to 200° F

Ftg. 6. After heating, the plastic becomes pliable and tube is bent to form an included angle of 115 to 120°

Ftg. 7. Final step, after tube has cooled, is to pour out the sand, which may be saved for possible re-use

Old Method

This practice has now become widely accepted among irrigation farmers throughout the Nebraska area, because it eliminates the strenuous work of "mudding in" the lath boxes for each row and the subsequent hazard of ditch breaks caused by leakage around the boxes.

Figure 1 shows the arrangement of an outlet box and the lath boxes commonly used in the irrigation of such crops as potatoes, corn or beets. The water level in the lateral is raised by means of a check dam. By raising the slide in the outlet box, a flow is allowed to enter the secondary ditch, from which water is measured into each row by means of lath boxes set in the bank of the secondary ditch.

Distribution

One retail firm, The Cozad Implement Co. of Cozad, Neb., realizing the merit of the tubes, arranged to become a distributor for them and to prepare them in advance for the farmer. The company has scarcely been able to keep pace with the large demand.

If manufacturers cut and bent the tubes at the factory, this would be a boon to irrigators, as it would doubtless result in improving the hydraulic flow characteristics of tubes, and in increasing rate of flow by flaring the ends. The rate can be increased at least 10% by this method.

Main types of plastics used for the tubes are Dow's *Saran*, Monsanto's *Nitron*, a Federalite thermoplastic resin, *Extruded Plastics' Tulox TT* and a cellulose acetate butyrate made by Detroit Macoid Co., the latter offering prebent tubes. Cozad has set up equipment which will bend 5000 tubes per day. It has been found that tubes bent by farmers themselves often collapse during the bending process. Some have found that placing a flexible metal tube inside the plastic, then heating and bending, improves results, since the metal does not bend sharply at any spot. After cooling, the metal is removed.

Post-War Uses

Permanency of the plastic siphon tube development is indicated by their weight and resiliency advantages over metal. Farmers drive over them with cars with no apparent damage. While costlier than such metal tubes as aluminum, they would not be as easily crushed. Resiliency in warm weather is another favorable quality of the plastic. A transparent tube has an advantage over colored plastic or metal tube in that the farmer can check water flow. Also, plastics do not rust or decompose with ordinary use. To last, they must have high impact strength.

END

More sales are made . . . turnover is greater and profits are larger . . . on products decorated with Meyercord Decals. Why?

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MEYERCORD *Decals*

THE MEYERCORD CO., CHICAGO 44, ILL. WORLD'S LARGEST MANUFACTURERS OF DECALCOMANIA

Lucite-Butacite— A New Plastic Laminate

Shatter Resistance and Self-Sealing Properties Achieved Through Use of Rubber-Like Interlayer

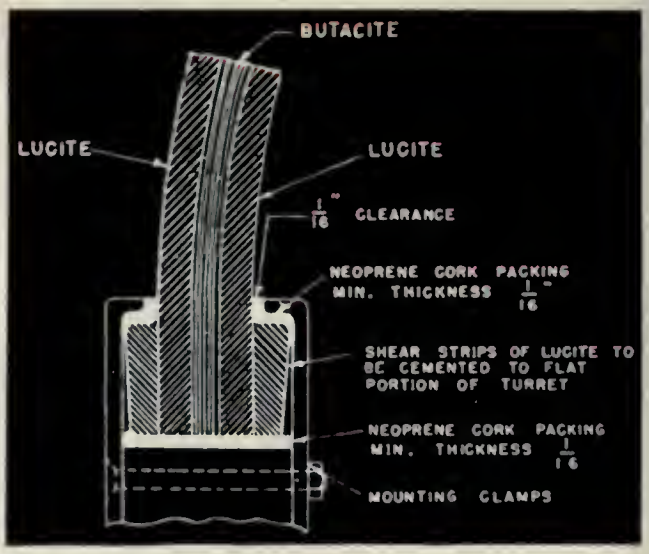
BY inserting sheets of *Butacite* polyvinyl butyral between two layers of *Lucite* methyl methacrylate resin, DuPont has achieved a new type of laminate which has high resistance to shattering and effectively reduces openings caused by various missiles so that internal air pressure, in the case of pressurized compartments, will not be instantly lost.

A progress report has recently been issued by DuPont revealing the results of significant tests made with the new sheeting in various forms, based chiefly on the types of shapes employed in aircraft enclosures. It has already been announced that the 3-ply enclosures play an important role in maintaining pressure in the cabins of the Boeing B-29 *Superfortress*. A hole made in transparent enclosures can easily be sealed after being pierced by bullets, before the air pressure of the compartment shows appreciable drop.

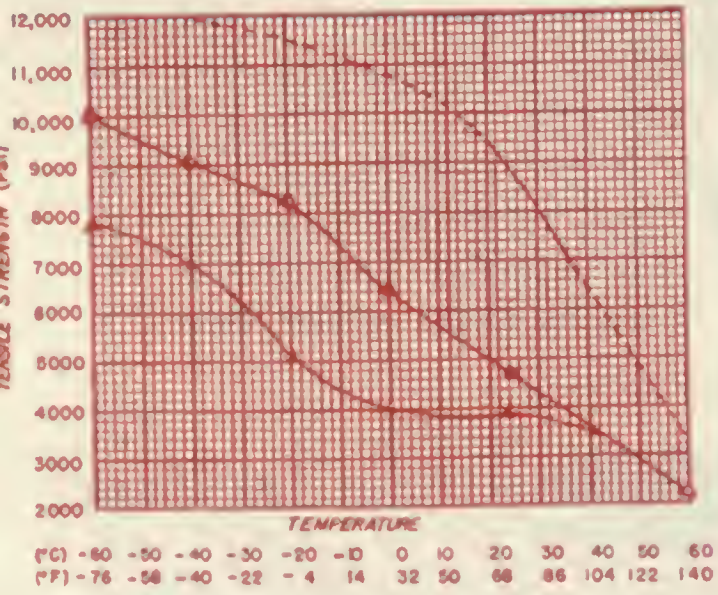
Comparison with Lucite

When using laminated *Lucite-Butacite* sheeting, pressurized bomber noses, gun turrets and blisters are not demolished when penetrated by bullets. At ordinary temperatures, and even under pressure, the hole left by the bullet is small, and the amount of shattering is not excessive. In most cases the hole may be sealed promptly with a patch. Solid acrylic plastics tend to shatter beyond repair when struck under conditions of low temperature and high pressure.

Experience gained by the company in the production of the rubber-like *Butacite* sheeting for the interlayers of laminated auto safety glass was the forerunner of the new plastic sheeting. The weight per sq ft of the laminate is less than that of an equivalent thickness of solid acrylics formerly used. It is equally as transparent, and is readily adaptable to a variety of mounting techniques which permit the elimination of obstructing metal parts and ribs from the line of vision.



Double-shear-strip type of stationary mount recommended for installing semi-cylindrical shapes of new laminate



Tensile strength with rapid loading. Circles represent new laminate before accelerated weathering; triangles afterward; broken line is solid "Lucite"

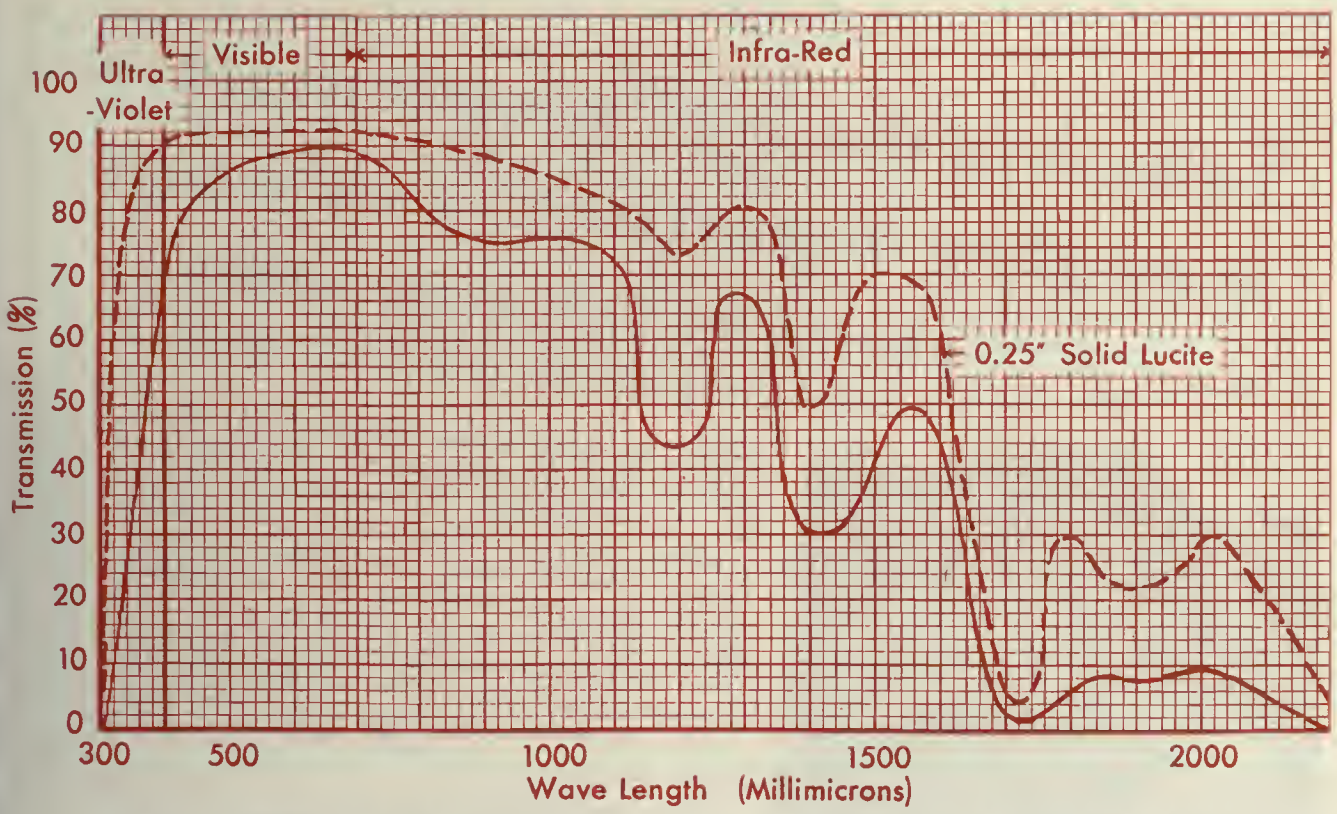
The value of the sheeting to low-flying aircraft is apparent, when it is noted that these are confronted with the hazard of birds and rupture from flying ice.

An important part of the research involved in developing the sheeting was played by a special adhesive to accomplish the lamination of the three plies.

Specific gravity of the sheeting is less than that of solid acrylic now used in aircraft structures. It can be formed and fabricated with the same ease as that now employed with solid acrylic. For hemispheres or similar deeply-drawn structures, compression forming by means of male and female dies or positive air pressure dies is recommended in place of vacuum drawing.

Test Results

Tests conducted with *Lucite* and with *Lucite-Butacite* sheets proved a marked contrast between the reaction of the former and the latter under pressurization to a bullet from a .50-cal. gun. In the case of semi-cylinders of solid acrylic 0.5" thick before forming at —40° F with a pressure differential of 7.5 psi, complete rupture of the entire unit occurred. In the case of a laminated *Lucite-Butacite* sheet of 0.375" thickness, a pressure differential of 7.5 psi, and at a temperature of 77° F, the *Butacite* effected complete sealing of both exit and entry holes. When the temperature was reduced to —40° F, the holes did not self-seal, but the size of the hole was small enough to retard pressure loss and permit quick patching.



Spectral transmission of laminated "Lucite-Butacite" of 0.4" thickness, indicating that the laminate absorbs more ultra-violet rays than does solid acrylic, a property which may prove of value in the minimizing of sunburn

The contrast between solid acrylic and the laminate was even more striking in the test of domes 50" in diameter with an 18" draw. Where the solid acrylic dome (0.5" thick before forming) completely disintegrated under fire, with an inside air temperature of 50° F and outside air temperature of —49° F, and a pressure differential of 5 psi, the laminate (0.625" thick before forming) showed only small holes under similar conditions of temperature and pressure.

The laminate dome, after being pierced, was patched and re-pierced in a different spot with the same calibre gunfire. The patched area remained intact, withstanding re-pressurization and the shock of a second bullet.

Mechanical Properties

Difficulties are presented in obtaining reliable data on the mechanical properties of laminated *Lucite-Butacite*, chiefly because it is a non-isotropic material made of outer-layers of rigid methyl methacrylate sheeting with inter-layers of flexible polyvinyl butyral sheeting. Variation in the ratio of thickness between outerlayers and interlayers makes a great difference in physical properties. Also, the direction in which a load is applied influences the values obtained. Most of the data presented in the accompanying graphs are based on laminates 0.4" thick, composed of 0.125" outerlayers and 0.15" interlayer, with values calculated on the entire cross-section rather than the *Lucite* alone.

Optical Qualities

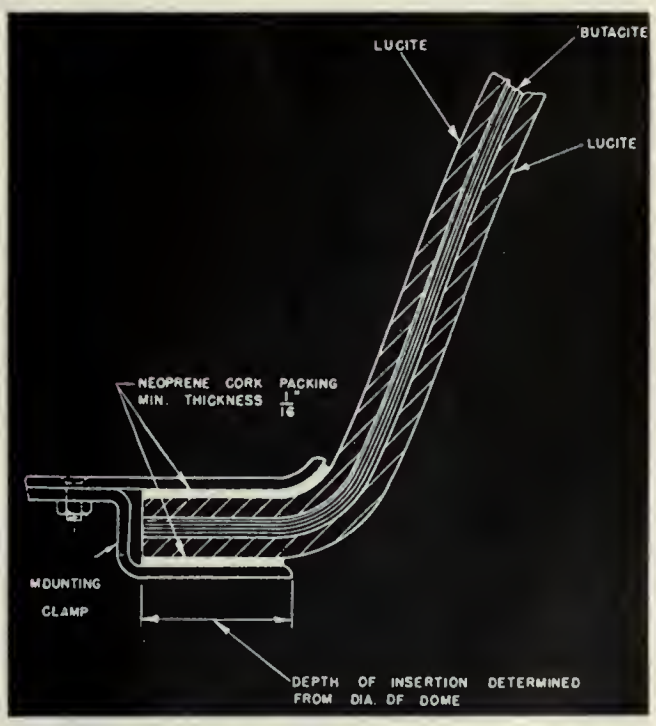
When properly manufactured and formed, the laminate's optical qualities are equal to those of a similar structure of solid acrylic of the same thickness. The refractive index of the laminate is 1.47.

Butacite gives a faint yellow color to the laminate, which helps reduce the intense glare of the sky at high altitudes. The interlayer also absorbs a large portion of heat-generating infra-red rays.

Thermal Properties

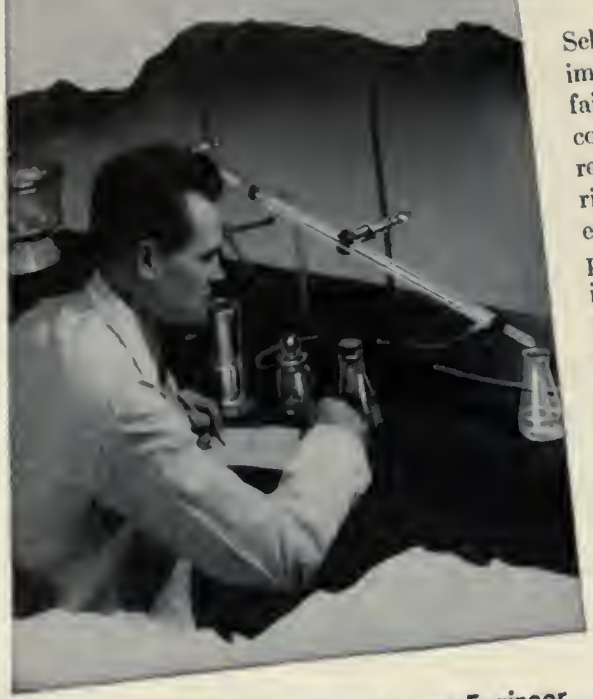
The lowest temperature at which the interlayer retains self-sealing tendencies is about 5° F or —15° C, above which the self-sealing occurs to some extent if the bullet is tumbled, and becomes more effective as the temperature

(*Continued on page 97*)



For pressurized application, this flanged mount is recommended, provided load is borne tangent to the dome

Selecting the *right* plastic material is mighty important . . . and it's largely a matter of selecting the right plastic molder



Selecting the plastic molding material for any job is important, for an error in judgment can mean complete failure of the molded part. There are so many factors to consider . . . tensile and impact strength, acid or water resistance, dielectric properties, and others. Your material must possess *all* the properties your specifications call for, not just one or two. Out of the hundreds of plastic molding compounds there is one best; but to find it requires more than charts. It requires the judgment that comes only with experience. It may even require laboratory tests and experimental work.

That's where a CMPC Development Engineer can be of material help to you. He knows materials, and he's backed by an organization with over 25 years' experience in plastics. Through him your problem becomes a problem for a group of specialists . . . engineers, designers, laboratory technicians, and production experts. Its solution becomes a matter of meshing their knowledge and experience with the requirements of your job. And because we are equipped to mold all types of plastic materials by any method . . . compression, injection, or transfer . . . your CMPC Development Engineer is free to make unbiased recommendations . . . to suggest the material and method that will produce the best results.

So . . . why not call in a CMPC Development Engineer . . . today, while your plans are still in the formative stage? Your request incurs no obligation whatsoever. And remember, he's backed by the largest, best equipped custom molding plant in the Middle West.

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- By analyzing your products to determine what parts, if any, can be advantageously molded of plastics.
- By helping you in the selection of the best material or materials for your job.
- By putting at your disposal practical experience with the latest wartime developments in plastic molding materials and methods.
- By furnishing preliminary cost estimates to help you in choosing the most economical production methods.
- By suggesting design for most effective and economical utilization of plastics.
- By making laboratory tests to determine suitability of materials for special applications.
- By building experimental molds for sampling and tests.

Even though yours may be a postwar project, you can, with the help of a CMPC Development Engineer, do all of this preliminary work now. Then . . . when priorities are lifted, you will be ready for immediate production.

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WHAT'S *New* IN PLASTICS

Synthetic Resin Glue

Casein Co. of America
New York, N. Y.

A synthetic resin glue, "Cascophen RS-216," sets at ordinary room temperatures, is boilproof, moldproof, and is reported to surpass the best properties of durable cold-set glues.

Relatively expensive at present, it is recommended for work where complete durability is required and where joints cannot be heated, such as the gluing of thick laminations for airplane propellers, heavy-duty built-up arches and beams, aircraft spars and assemblies, etc. .....(74)

Tenite Scales

A. Leitz Company
San Francisco, Cal.

New *Tenite* architects' and engineers' scales are molded by American Molding Co., San Francisco, for A. Leitz Co. of that city.

These all-plastic scales are said to be much more accurate and less likely to warp than those of box wood to which strips of cellulose nitrate are cemented.

The Tenite scales are white, with easily legible black lines and figures. Stripes in different colors painted on each side of triangular scales facilitate finding the desired scale.....(75)

Fuel Gages

Celanese Corp. of America
New York, N. Y.

Transparent, non-shattering plastic fuel gages have been developed employing either *Lumarith* or *Celluloid*. The gages come in a variety of thicknesses and lengths and are used in planes, tanks, amphibia, and on many types of war and industrial machinery.

The demand for these gages is extremely high because severe impact does not dent or break them. However, this need is being met without difficulty due to the fact that the gages can be speedily and economically made of *Lumarith* and *Celluloid* products of the Celanese Celluloid Corp., Plastics Division of Celanese Corp., by any of the more common fabricating processes .....(76)

"V"-Way Hydraulic Vise

Reimuller Bros. Company
Franklin Park, Ill.

Rugged, "V" ways, semi-steel, with precision construction and simplified, all steel hydraulic foot control, are features of this hydraulic unit.

The vise is designed to meet the problems of mass production as well as being especially suited for holding or handling material. The unit can be mounted vertically and used for a production press on small precision upsetting, heading and other small operations requiring dies or tooling.

Only two levers are used in the hydraulic foot-control. One to apply pressure up to rated tonnage; the other for release which has a two speed return. No outside air lines or power are needed and unit is self air eliminating. Operators' hands are free for work.

The new vise is portable in that it is equipped with flexible hydraulic hose which lends adaptability to use on other machines. Two sizes are available: 4 ton with 4″ opening, and 7 ton with 7″ opening.....(77)

Plastic Foam

General Electric Co.
Schenectady, N. Y.

A plastic foam, reported to be lighter than rock wool, glass or cork and lower in heat conductivity than any of the three, has been announced. Its present uses are secret but after the war it promises to have many peace time applications, especially for insulation. (See photo below).

The material is self-raising and self-curing; resembling molasses, it will begin to foam or expand within 2 to 5 min after mixing stops and cures without application of heat or any other element. It will foam into 30 times its own size in about 10 min. What little heat is needed is self-generated by the mixture itself.

This type of foamed plastic weighs less than 2 lb per cu ft, while another type, of greater mechanical strength but weighing 7 to 8 lbs per cu ft, has also been developed.....(78)

To simplify for our readers the task of obtaining detailed information regarding the new products, processes and trade literature described herein, PLASTICS offers the prepaid postcard inserted here.

In rapidly-moving times such as these, keeping up with every latest development in one's field is a "must." War's insatiable demand for swifter production, and the competitive drive toward lower manufacturing costs require that all avenues leading to a solution of these problems should be explored thoroughly.

Each item in this section is keyed with a number, which should be entered on the postcard to facilitate identifying the exact product, process or publication about which information is desired.

Acid Tank Lining

E. I. DuPont de Nemours & Co.
Wilmington, Del.

Resistance of methyl methacrylate resin to attack by acids is the basis for use of the plastic as lining for 28,000 gal tanks holding chromic and sulfuric acid anodizing solutions in the treatment of aluminum alloy aircraft parts.

Sheets of Lucite line the huge tanks in which aluminum parts are given surface oxidizing treatment at the Curtiss-Wright Corp. plant, Columbus, O. They are reported to have extended the life of the tanks indefinitely. *Lucite* is not affected by sudden temperature changes nor by the 15% chromic acid solution. (See photo above).

It is stated plant officials have found *Lucite* less expensive, lighter, less subject to breakage, and easier and safer to handle than the material which the plastic replaced. The linings were installed as the result of the company's experience with *Lucite* tubes as insulation for parts while exposed to electrolytic action of acid baths. The plastic was credited with doubling output of anodizing equipment at the plant.....(79)

Flameproof Cloth

United States Rubber Co.
New York, N. Y.

A glass, flameproof, synthetic rubber coated cloth has been developed with great tensile strength at abnormally high temperatures, extreme lightness in weight and high tear resistance. It is fireproof, gasoline proof, oilproof, greaseproof, waterproof, mildew and insectproof, and not affected by acids or alkalis.

An important use is to protect personnel in *Superfortresses* and *Flying Fortresses* at high altitudes by eliminating possible breaks in metallic heating ducts caused by vibration and other factors. By sealing joints in metallic hot-air ducts, this material gives the plane's heater system greater efficiency, insuring essential, quick distribution of heat.

In fast combat planes operating at high altitudes, small openings have to be left between joints of metallic hot-air ducts to allow for vibration, expansion and contraction. Sealing these openings tightly with a light-weight cloth, strong enough to withstand the great heat that passes through the hot-air ducts, has for years been a problem to aviation experts. The development of synthetic coated flameproof glass cloth solved the problem.

Double-coated, this same glass cloth is also being used for gun bore aligning targets, as it retains it shape without stretching or distortion of the gun sighting pattern. The new type targets act as a means for frequent checks of gun bore alignment with the gun sighting telescope.

Finished weight of the double-coated glass cloth is only 7.6 oz per sq yd, and the single-coated cloth used for the metallic hot-air duct weighs only five oz per sq yd.

Aviation companies at present employing this material in aircraft building are also testing it for many other war uses. Made in a variety of gages from 0.006" to 0.040" and in tensile strengths from 165 to 800 lb per in, many post-war uses are indicated. .....(80)

In the October issue of *plastics*—

FABRICATING ACRYLICS

Second in a series on fabricating techniques, this article will give thorough and comprehensive advice on the proper methods to employ in fashioning objects of acrylic materials when using ordinary metal-working tools on machinery designed for wood-working. Full description of operating speeds, feed rates, lubricants, tool sizes, jigs and fixtures.

Subscribe to *plastics* today

Time Delay Relay

R. W. Cramer Co., Inc.
Centerbrook, Conn.

Model TD6 time delay relay was developed to protect transmitter and electronic tubes.

It has a cam-operated switch mechanism; is mounted in dust and moistureproof *Bakelite* case for panel mounting; and has a visible index showing open and closed position by means of graduated indicating dial, and four screw-type terminals for motor and switch circuits. A totally enclosed switch unit is used, having definite snap action and positive lock in both operating positions. .....(81)

Electrical Indicating Instrument

W. W. Boes Company
Dayton, Ohio

These instruments are housed with cases and bases molded by Peeto Molded Products, Inc., Cincinnati, from *Bakelite*.

They are designed to withstand the effects of stray magnetic fields, salt spray, shock of rough handling or plane vibration to which they may be exposed. .....(82)

Moisture Meter

C. J. Tagliabue Mfg. Co.
Brooklyn, N. Y.

This dielectric type moisture meter is designed for measuring the moisture content of powders or granular materials such as dehydrated foods, soaps, flour, plastic molding materials and items for which their other electrical conductance instruments are not suitable.

The meter is planned for precise measurement of the dielectric property of a test sample, and it is electrically simple but extremely sensitive. This sensitivity is not only the result of a unique electronic method but also advantage is taken of the fact that the dielectric constant of water is about 80 while that of common substances is less than 10. Thus, a slight change in moisture content has a marked effect (in nearly all cases) on the dielectric constant of a substance. The manufacturer states that, by using this meter, moisture determinations can be made in less than 2 min. .....(83)

Transparent Machinery Models

Stricker-Brunhuber Corp.
New York, New York

The firm specializes in developing transparent working models to demonstrate operating principles of certain types of devices. These have five chief values: One is to provide key personnel with a preview of a proposed product, thus putting the designer's ideas in actual form; second, to provide a means of checking the product's actual against its pictured appearance; third, to gauge what the sales appeal will be with prospective customers; fourth, to judge tolerance requirements, operating costs and possible difficulties in production can be anticipated, with consequent savings in tools and dies; and fifth, mechanical operations can be studied in advance of manufacture..(84)

Formica Forming Press

Formica Insulation Co.
Cincinnati, O.

Cut blanks of laminated *Formica* can now be fashioned into a variety of shapes with the aid of a forming press. Heretofore, it was necessary to build molds to shape the material.

The engineering department at the plant, however, with the aid of aircraft engineers, found that the cured sheet could be heated to a temperature just under the blistering point, and, if stamped quickly, could then be formed to shape. This shape is maintained by the product.

The press (above, with raw material at left and products at right) used has inexpensive dies of wood or *Pregwood,* the latter a *Formica* laminate used in propellers.....(85)

New Type Goggle

Polaroid Corp.
Cambridge, Mass.

Men of the U. S. Army Air Forces are now being equipped with a new *Polaroid* goggle, which enables fliers to see in every direction because it is equipped with an 8" plastic shatterproof lens extending from one side of the face to the other. Frame and lens together protect eyes, cheeks and forehead from frostbite caused by sub-zero stratosphere temperatures and from burns caused by flash fires around fuel and oxygen lines which have been hit by incendiary bullets.

Officially designated AAF Type B8, the new goggle was designed by Polaroid engineers in cooperation with the AAF Materiel Command. The flexible frame of the new goggle fits all shapes and sizes of heads and faces.

Each B8 goggle comes in a kit which contains interchangeable green, amber and crystal-clear plastic lenses. The clear lens provides wind-protection; the green is for sunny days; the amber makes haze-covered targets easier to see.....(86)

Thermo-Electric Glue Heater

Divine Bros. Co.
Utica, New York

This multiple pot system in cabinet type consists of the following: Full set of pots with covers, one thermometer, one glueometer, measuring dippers—one for water and one for glue included.

The heater offers many advantages, among which are: (1) By heating glue pots in rotation, it is possible to have

Featured in the next issue of *plastics*—

PREVIEW OF "VELON"

Complete details concerning a new plastic upholstery fabric with extraordinary characteristics and vast potentialities for expansion into new fields, competing with wool, leather and mohair. Woven from extruded vinylidene chioride fibers, it is highly resistant to a wide variety of influences.

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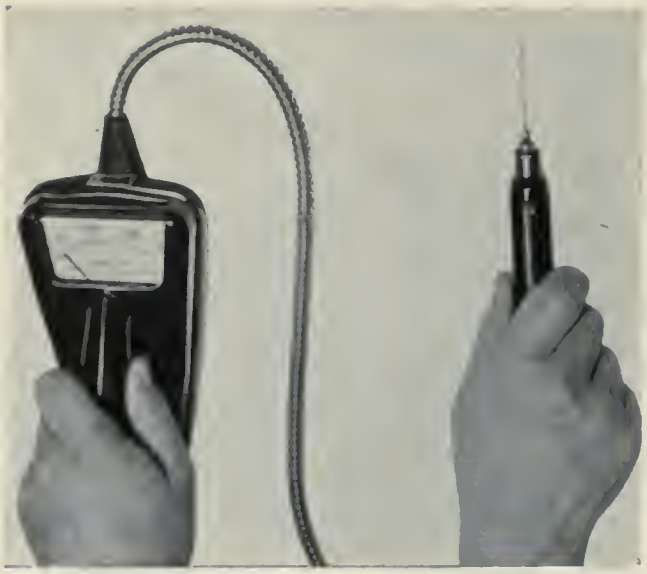


fresh, strong glue at all times; (2) Wheel heads last longer, polish more pieces per head; (3) A separate pot for each grain size prevents mixing coarse with fine grains eliminating unnecessary scratches; (4) Pot covers keep the heating glue clean, keep water tank hot when pots are removed, prevent forming of glue scum which must be skimmed off; (5) Polished aluminum (or spun copper) glue pots, fitted with handles for easy lifting, make possible fast cleaning; (6) Glue density, important to wheel head success, is controlled to exacting batch-to-batch uniformity by glueometer and dippers.

The thermostats controlling the temperature at all times, make it simple to run and the insulated water tank make it economical .....(87)

Needle Pyrometer for Pre-Heat Testing

Cambridge Instrument Co.
New York, N. Y.

New application involving determination of temperature of preforms heated by high frequency current when either thermosetting or thermoplastic materials are used.

The instrument gives a reading instantly upon insertion of the needle into the preform, thus providing a means for adjusting the time-cycle of the pre-heater for close temperature control. It may also be used in checking the uniformity of heating throughout a single preform. (Photo left.)

Combination Cambridge instrument models are available which have interchangeable roll, mold and needle thermocouple attachments .....(88)

Heat-Resistant Vinyl Tubing

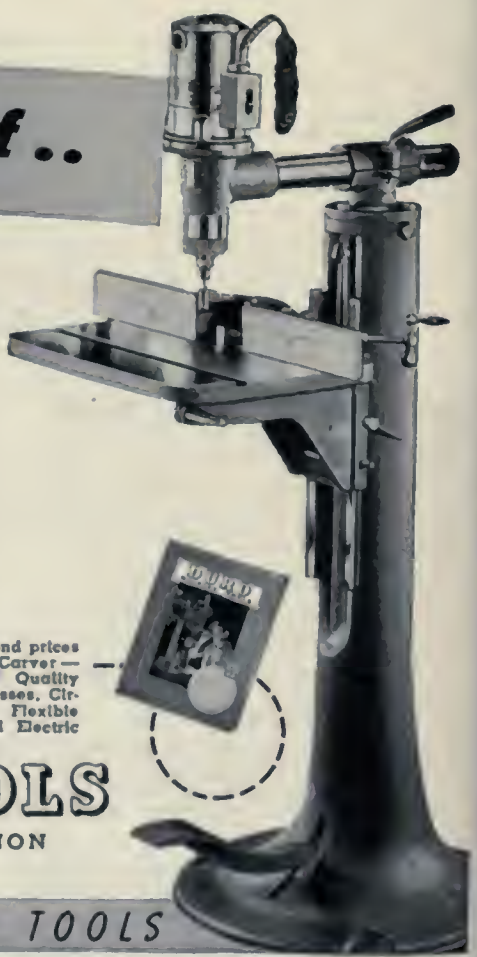
The National Varnished Products Corp.
Woodbridge, New Jersey

Designated as *Natvar* 400 Series, the new tubing has the same electrical properties as conventional tubings, but with far better heat endurance, resistance to oil embrittlement and resistance to gasoline-benzol. It is available on the same priority as standard vinyl tubing.

Wires insulated with the product may be soldered without special technique and without flow or opening of the tube at the soldering point. It has a tensile strength of more than 3000 psi, with elongation from 170% to 410%, and remains flexible down to —80° F. It is chemically inert, and is suitable for oil lines, sheathing and other protective coverings where adverse oil, solvent or acid, vibration and temperature conditions are severe.

Dry dielectric strength average 1000 v per mil; after dipping in tap water for 24 hr, it averages 800 v per mil and over. The power factor at 60 cycles and at room temperature is 6%; d-c insulation resistance is 15×10^{10} inohms .....(89)

Quickly pays for itself ..



A New Low-Cost DURO Quality SHAPER, CARVER, ROUTER

This new three-in-one Router, Carver and Shaper has proven a boon to metal-working shops. It is ideal for routing non-ferrous metals and many other operations. Can be set up for time-saving duplicate routing and veining.

Combines high speed (20,000 R.P.M.) power (1200 watts at the spindle) and solid, heavy construction that gives smooth, vibrationless cutting. Is extremely flexible—can be transformed quickly into a Shaper. Standard equipment handles ¼", 5/16" and ⅜" bits for routing—5/16" and ½" shaper cutters. Has many special features including: Specially designed G. E. Universal Motors, New Departure Precision ball bearings, precision machining throughout: Table can be instantly adjusted to any height without holding foot pedal. Chuck is part of spindle and holds adaptor and cutter extremely close to work thus preventing whip. Many other exclusive features. Unusually low-priced.

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Gentlemen: Please send me FREE copy of latest DURO Catalog giving full specifications on new DURO Shaper-Carver-Router and other DURO Machine Tools.

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Literature Review

Self-Tapping Screws

Parker-Kalon Corp.
New York, N. Y.

Engineering and production data about the application of self-tapping screws is given in the new Users' Guide; 18 pages file size, tab-indexed, spiral bound, and arranged with wall hanger. Included is a selector chart telling at a glance which of nine types of self-tapping screws to use in various materials. Tables give recommended hole sizes, stock sizes and data on use of each type of P-K self-tapping screw under different conditions.

Application information covers use of self-tapping screws in sheet metal, steel, castings, plastics, plywood, asbestos and other compositions.

Because of paper shortage and cost of the unit, distribution of the publication is limited to engineering and production executives. .....(90)

Extruded Parts Catalog

B. F. Goodrich Co.
Akron, O.

Data about the process of extruding, and products that can be made from natural, synthetic and reclaimed rubber and plastics, is contained in a 12 page illustrated catalog "The Process of Extruding."

It tells how two different materials can be extruded together to produce a reinforced part, such as a rubber-coated masonite strip used in refrigerators; or a piece of sponge rubber cord extruded with a smooth rubber coating on all sides to form a tubular gasket of high compressibility and low permanent set; and how cork can be introduced into rubber compounds for the extrusion of light, flexible insulation tubing. Manufacturing limitations — how hard or soft the stock may be and size limits of various shapes — are also given. .....(91)

High Frequency for Preforms

Federal Telephone & Radio Corp.
Newark, New Jersey

To meet the need for introductory literature explaining *Megatherm* electronic high-frequency heating of preforms, as displayed at the Plastics Industry Trade Show in Chicago, the company has issued a folder outlining the principle behind the process and selected applications.

Two types of heating are described—dielectric, in which common organic materials can be heated uniformly and speedily; and inductive, used for case hardening, brazing, soldering, spot annealing and general heat treatment. .....(92)

Precision Lathe Line

South Bend Lathe Works
South Bend, Indiana

Varied work of precise quality can be performed by a line of lathes produced by this company, according to Catalog No. 150 just published. Lead screw thread is tested for accuracy of lead with optical measuring equipment accurate within .00005" in 30".

Several of the units feature the underneath motor drive, enclosed in a cabinet below the headstock and providing many spindle speeds ranging from 21 to 1357 rpm.

Attachments and accessories available include a taper for turning and boring all types of tapers, draw-in collet chuck attachment, milling and keyway cutters, electric grinders, chip and oil pans, thread dial indicators, micrometer carriage stops, center and follower rests, handlever double tool cross slides and handlever bed turrets. .....(93)

CURTIS Air Compressor

"Vital to Our Wartime Operations"

Says Bronze Alloys Company

Having recently installed a new Curtis Air Compressor due to an increased demand for air, Mr. Albert Vigne, President of Bronze Alloys Co., St. Louis, writes:

"The air from this compressor is used throughout our foundry to operate molding machines, vibrators and air tools such as chipping hammers and hand grinders. As you know, *a dependable and uninterrupted source for compressed air is vital to our operations*—we can't do without it. To say that we are elated with the performance of our new Curtis Compressor is putting it mildly.

"We do not know the age of our other (Curtis) compressor ... it is being held by us in reserve for emergency needs. The old compressor ... was purchased in a used condition. It has served us faithfully, and were it not for the fact that our increased operations demanded more air, we certainly would be using it continuously because it is in excellent condition ..."

Thus, another user of Curtis Model "C" Air Compressors expresses complete satisfaction with Curtis performance—a tribute to Curtis engineering, precision construction, and all-round rugged quality.

Curtis Air Compressors are Timken Bearing equipped and available in capacities up to 300 CFM. Send the coupon for complete information and free booklet, "How Air Is Being Used in Your Industry."

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● Please send me your free booklet, "How Air Is Being Used in Your Industry," and further details concerning Curtis Model "C" Compressors.

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Firm.....
Address.....
City.....State.....

Electronic Tube Booklet

Amperex Electrical Products
Brooklyn, N. Y.

An illustrated booklet "It Was a Tube They Wanted" graphically tells of the importance of tubes.

Among the illustrations of some of the workings of electronic tubes, are many dealing with intricate plant operations. Precise small glass lathe operations, pre-evacuation processes, production testing, static and dynamic testing, life testing, welding, assembling, soldering sealing, and hand glass blowing, all of which go into the making of tubes.

A wider acceptance for the "custom built" tubes which are being used even today in communications, medicine, science, agriculture and industry, including such applications as metal analysis, metal surfacing, wood glueing, induction heating, and motor control, is indicated.....(94)

Phenolic Plastics

Continental Diamond Fibre Co.
Newark, Del.

This 10-page, illustrated, bulletin FP43 "Design and Fabrication of Laminated and Molded Phenolic Plastics and Vulcanized Fibre Parts" contains drawings of right and wrong ways to design molded parts.....(95)

Fairprene

E. I. DuPont de Nemours & Co.
Fairfield, Conn.

A technical service manual on *Fairprene*, a flexible bag and blanket material from DuPont's Fabrikoid Division, states this material can withstand not only the application of steam alone but also a combination of steam and compressed air at the same temperature. It is a specially compounded, high heat-resistant, synthetic elastic composition applied to both sides of a sturdy woven fabric for bag use, and calendered in sheet form (without fabric insert) for blankets.

An illustrated description of laying out, cutting to size and cementing the molding bag is given as well as an application outline .....(96)

Three Dimensional Seeing

E. I. DuPont de Nemours & Co.
Wilmington, Del.

The third publication offered since this system of applying color to improve industrial seeing conditions was announced before the IES in 1941, this 20-page booklet, "Three Dimensional Seeing, The Science of Color and Light For Better Vision in Industry," contains information derived from color-conditioning installations in more than 1000 plants. Recent results of a continuing Du Pont research program are stated for plant management, maintenance and safety engineers.

Included in the color-illustrated brochure is a section "Safety Color Code For Industry," a corollary to "Three-Dimensional Seeing." The Color Code recommends as a standard using specific color signals and symbols to denote specific hazards and safety equipment.

Photographs, many of them paired as "before-and-after," show how contrasting colors increase production, reduce injuries and improve morale in machine shops, textile mills, garment and furniture factories, etc. .....(97)

Geon Resins and Plastics

B. F. Goodrich Co.
Akron, O.

Technical bulletin PM2 deals with Geon resins and plastic compositions, vinyl chloride polymers and copolymers produced by the Chemical Division of B. F. Goodrich. It contains detailed tables and listing of typical formulations .....(98)

ABC of Luminescence

The New Jersey Zinc Co.
New York, N. Y.

A 24-page booklet, discussing in simple language, characteristics, properties, limitations and applications of inorganic, luminescent pigments .....(99)

ENGINEERING
News Letter

By LEWIS WINNER
Market Research Engineer

Applications . . . Methods . . . Materials

A most unusual laboratory instrument that has recently become an exceptionally valuable tool of the plastics' engineer, is the spectrograph. This device spreads light emitted by metals, gases, compounds, etc. The light is spread into a spectrum which consists of lines and bands characteristic of the material. It is then recorded on a photographic plate or on a sheet of paper with a pen that is electronically controlled. Associated with the spectrograph is equipment that excites the spectra and also serves to interpret the spectrographic record. Recently tests were made to identify and determine the amounts of organic and inorganic compounds in samples by measuring their absorption characteristics. In one instance, at Bell Laboratories, the amount of plasticizer in cellulose acetate products was determined. The absorption data served to provide a composite curve. This curve was plotted with wavelength in millimicrons on the absissa against absorption (K log I_0/I) on the ordinate. From these graphs the amounts of dibutyl phthalate and triphenol phosphate in the plastic can be determined to about 50 parts per 1000. The absorption is expressed in terms of the logarithm of the ratio of the incident to the emergent light intensity.

Silicones

A comparatively unknown class of organo-silicon oxide polymeric material, *Silicones,* was recently displayed in New York. These silicones were developed to provide a varnish or resin that would be suitable for use in holding glass fibre insulation in place, and for filling voids to keep out moisture. Silicones are polymers in which organic groups comprising carbon and hydrogen are attached to a silicon-oxygen chain framework. From this structure, silicones derive the heat resistance and some other properties of silicates, together with some of the more desirable properties of organic or carbon compounds.

In obtaining silicones, sand provides the silicon. Then brine provides chlorine to produce silicon tetrachloride, and also magnesium, by means of which the organic constituents derived from coal and oil are attached to the silicon. No magnesium or chlorine remains in the end products.

Upon hydrolysis with water and further treatments the

Silicone 993 and 2052

Properties	Silicon Resin 993	Silicon Resin 2052
Solids content (dried 3 hr @ 135° C— by weight)	70%	60%
Density (@25° C)	1.075	1.022
Weight per gal (lb)	8.97	8.51
Viscosity (poises @ 25° C)	6-12	2-5
Drying time to tack-free condition		
At 250° C (hr)	1-3	
At 225° C (hr)	6-15	
At 175° C (hr)		1-3
Setting time to complete cure		
At 200° C (hr)		3-6
At 225° C (hr)		1-2
Heat endurance (hr at 250° C)	50	
Electrical Properties*		
Power factor (% at 1000 cycles)	0.30-0.70	0.20-0.30
Dielectric constant (1000 cycles)	3-4	3-4
Dielectric strength (v per mil)	1500-2000	1500-1800

*(Tests on 4-mil fibreglas cloth, coated with the silcon resin 993 or 2052, to a thickness of about 7 mils and cured until tack free; samples conditioned at 25° C, and 50% relative humidity.)

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Looking for A New Industrial Location?

MANY manufacturers and processors of plastics are looking for new locations because they want to be ready for a bigger share of the peacetime markets now being created for plastics.

More and more of them are turning to the Central West and Southwest served by the Missouri Pacific Lines. It's a big and growing industrial empire, stretching from the Mississippi to the Rockies, from the Missouri River to the Mexican border, embracing all the Gulf ports from New Orleans to the Rio Grande. It offers in abundance many of the basic materials for the production of plastics, and pioneer producers in this territory are assured of tremendous initial and ever-increasing markets, for certainly every branch of the plastics industry will be represented there.

If you are looking for a plant site in the Central West and Southwest you can count on the cooperation of the Missouri Pacific Lines' Industrial Development Department. Our Mineral Technologist and Industrial Engineers are at your service. Studies and surveys to fit your special needs will be made on request, and your inquiry will be handled in strict confidence.

MISSOURI PACIFIC LINES

Write, wire or telephone
J. G. CARLISLE
Director, Industrial Development
1710 Missouri Pacific Bldg.
St. Louis (3), Mo.

intermediate products are converted to silicones.

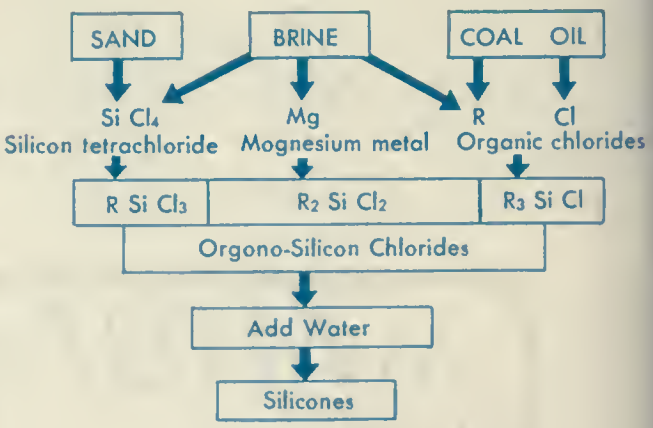
These resultant silicones range in form from liquids to solids, depending upon the intermediate materials used and on the methods used in preparing the polymers.

The silicon resin known as 993 is a heat curing, high temperature silicon varnish recommended for impregnating motor stators, transformer coils, and other non-rotating coils; for varnishing fiberglas or asbestos served magnet wire, and varnishing fiberglas, mica, and asbestos electrical insulating cloth, tape, sheets and sleeving. Another resin available is identified as 2052. This is a light-colored clear varnish, supplied as a 60% solution in tuolene unless otherwise specified. This resin can be set with heat to form a solid structure which will not liquefy or soften at a temperature of 200° C. It was specifically developed for impregnating rotating equipment which operates at high temperatures.

The Corning Glass Works, Dow Chemical Co. and Mellon Institute participated in the development of this organic polymer.

Hot Forming

Hot-forming or working has become quite popular, thanks to the development of improved fabric-base laminated phenolic materials. Hot-working is analagous to hand-drawing and stamping, conventionally applied in metal sheet work.



No elaborate tooling is required. Hard wood, metal, or phenolic materials such as panelyte, can be used as a forming guide. Plaster or certrock dies can also be used. In forming, either arbor presses, fast acting hydraulic or pneumatic presses, toggle or cam-acting presses are all appropriate. In fact, where thin materials are being formed, it is possible to use toggle clamps or dead weight. It is not necessary to use high pressure or heavy equipment. The only definite requirements are that the press be quick acting and of such design that pressure may be maintained for a short while. The usual type of punch press, for instance, would not be acceptable for this work.

Heating Methods

Any one of several methods for heating may be used. These are, hot oil or metal baths, hot air, and infra-red lamp ovens. Because of the slow rate of heat transfer, the hot air method is the least desirable. The rapidity of the material's acceptance to high heat without blisters determines the heating technique to be employed. For material about 1/16" thick, the heating cycle should be from about ½ to 1½ min. Thicker material requires an increase in the heating schedule. If a hot liquid bath is used, the liquid temperature should be around 350° to 500° F; amout 420° F has been found to be the best temperature. In infra-red operation 250 w reflector bulbs placed approximately 3" apart and on both sides of the sheet, are ordinarily used. If an oven with these lamps is used, the lamp spacing should naturally be increased.

plastics overseas

By KENNETH R. PORTER
Plastics' London Correspondent

German Lantern

Similar in appearance to an old-style kerosene buggy lamp, a nearly all plastics army field service lantern, lit by acetylene, has been taken from German prisoners. It consists mainly of three parts: the body, which houses the burner; the generator; and the water tank and burner assembly. For the most part, sections of the lantern are riveted together with liberal use of metal reinforcement.

Aircraft Propellers

One of the leading British aircraft propeller manufacturers claims to have developed a blade of laminated plastics which is, weight for weight, three times stronger than steel. The material consists of a series of laminations or veneers of selected woods impregnated and bonded together in huge hydraulic presses under terrific pressure and heat. According to the manufacturer this new plastics is "several times as strong as natural wood and has greater strength/weight ratio in tension and compression than aluminum or any other metal or material." This improved propeller is standard equipment on such aircraft as the British *Spitfire, Hurricane, Beaufighter, Halifax* and *Wellington.*

HF Seom Welder

A machine for high frequency seam welding of thin sheet plastics and plastic-impregnated fabrics has been developed and is being manufactured by Diaplastics Ltd., London. The machine will weld material up to 1/32" in thickness with speeds between 1 and 6 fpm. It is a self-contained mechanism with driving motor and HF generator supported in a tubular steel framework. A variable tuning transformer provides for the tuning of the generator to the welding job being performed. Interchangeable welding rollers allow for several widths and profiles. Most of the present output of these machines is engaged in doing British government war work.

Dermatitis

According to a British laboratory report sufferers of dermatitis contracted from certain synthetic resins and plastics materials have found relief through the application as an external ointment of certain maize oil preparations containing combined linoleic and linolenic acids. Similar preparations in the form of capsules are taken internally.

Engine Parts

No longer beyond the realm of possibility is a reinforced-plastics engine. Experimental connecting rods have already made their appearance along with various other component parts. It is now conceivable that an entire power unit could be produced of the same materials.

Welding School

Indications are that a school for the teaching of plastics welding might soon be started in London. It would be based on the instruction methods claimed to have been originated in Germany in 1939 which was advertised as the only school of its kind in the world. The Germans taught the new art in three courses, one lasting 2 weeks and two 1-week courses, one for pipelayers and fitters and the other for engineers. On the basis that "thermoplastics can be welded like metals," this new technique was looked upon as having an exceptionally important future as artificial resins were substituted more and more for non-ferrous metals. END

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That ought to make us reasonably well acquainted with the subject, and it should suggest to you that we can be of real assistance to you in helping to solve that molding problem. We know (1) the kinds of molding materials, (2) the characteristics of each, and (3) the way they should be handled to get the best results. We can help you from design to finished piece.

At the present time we are working 100% on war orders, but we'll be glad to discuss future plans.

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Plastic Molding

CAPITAL Report

By Arnold Kruckman

PLASTICS' Washington Correspondent

PLASTICS is one of the few industries, broadly considered, that has a minimum of reconversion problems from the Washington viewpoint. The general assumption here is that plastics will start its peacetime business with an annual production of $1,000,000,000. Government people anticipate such varied and eager demand for consumer and industrial goods, plus a continued military need, that it will be from two to five years before the plastics industry can even think about export. Meanwhile, the requirements of Europe and Asia and South America are expected to be so insistent and so great that the production abroad will not be able to supply the needs which can be filled only by the advanced arts and skills created by the products evolved in America by the war. There is so little the infant industry abroad can supply, that the rest of the world will be practically dependent upon America for its plastics.

* * *

From the Washington angle it appears the industry as a whole is well prepared to switch to post-war production. Government observers do not foresee that any unit of the plastics industry will be obliged to shut down. Almost all of them are understood to have made plans for the type of production and distribution of their peacetime items. Practically the only condition that might interfere with the uninterrupted continuation of any unit is assumed to be poor management. Every operator is supposed to have explored the means of securing materials now tightly restricted as soon as the controls are relaxed. Probably the chief practical problem will be the transition from the present 24-hour working schedule to the 8 or 10-hour overall schedules that probably will come after the war. Unquestionably government, both federal and state, will impose regulations which will force some form of spread-the-work in order to absorb unemployed.

Price Ceilings

The extent to which the industry is looking ahead is revealed in a query that has reached OPA. The correspondent said he was already preparing to make radio cabinets, and that he expected to start soon, and he wished to know about price ceilings. OPA has not yet been able to dispose of its war price ceiling problems and therefore naturally has no policy to govern post-war civilian prices.

There may be some comfort in Administrator Bowles' recent statement that it was his general idea that it would be OPA policy to guide the civilian economy back to the place, as rapidly as possible, where it may establish its peacetime prices by the usual competitive practices of pre-war American economy. This, however, should not be regarded as a defined promise of official policy. It also has been pointed out here that the industry, like other industries, will need new machinery and new equipment and fresh supplies of all kinds. But, unlike most other industries, the plastics industry will broadly continue at the same pace which has characterized its tremendous expansion since Pearl Harbor, and it will therefore relatively require far more new installations. This spells, specifically, a high degree of business for the plastics machinery suppliers, and for those who supply other equipment required by the industry. In turn, this means the plastics industry will be one of the few national activities which from the day the peacetime production begins will be able to stimulate additional absorption of unemployed.

Re-employment

There are abundant signs that many veterans plan to get into the industry when they return. Many letters are now coming in from those who left the industry when they went into service. Technological changes have been so amazing in the past year or two that it is anticipated there will be problems in re-orienting these veterans to the essentially new industry they will find when they get back. It is regarded as fortunate that municipal school systems and the colleges and universities, and other technical institutions, have recently begun to initiate facilities to train men and women in the many phases of the production of plastics. Many, who formerly made this training a subordinate part of the general subject of chemistry, are setting up departments which teach all parts of the subject of plastics. Veterans will therefore be able to obtain thorough training in almost any school they choose.

The GI law enables them to enter any school they select. And some of them will undoubtedly use their financial credit, provided by the government, fixed basically at $4000, and correlatively ranging as high as $10,000, to find some way of getting into some phase of the industry on their own, either individually or as co-owners.

Export Markets

Commerce Department recently published a survey which shows it anticipates South America will be one of our earliest export markets for plastics. Before the war the Germans and the British dominated the Latin American market. *Gallalith*, a casein rennet plastic, and *Pollopas*, a urea type synthetic, came from Germany. They were found, and are largely still found, in most South American countries. Gallalith is now made commercially in Argentina, which also produces alkyd resins and phenol-formaldehyde molding powders. There are six or seven important Argentinian firms, and numerous smaller units, which fabricate semi-finished plastics. Many finished products made from thermosetting plastics are manufactured

in Argentina. Novelties, low-cost goods, offer the largest market, as is true in almost all South American countries. The list of products besides novelties includes electrical equipment, telephone receivers, medicine bottle caps, pipe fittings, valves, instrument housings, paint, varnish, dental plates, belts, garters, suspenders, tableware, combs, dominoes, handles of all types, and spectacle frames. The industry is expanding, and in Argentina seeks machinery and raw materials. Argentina is the foremost market in South America.

Brazil produces two-thirds of its own semi-finished plastics and more than half of its finished products. It has approximately 200 firms dealing in plastic materials. They center on Sao Paulo and Rio de Janeiro. Cessation of imports from Japan and Germany has given a strong and amazing impetus to its own chemical production. It has a much more limited list of popular articles, and uses many plastic buttons and toys, unlisted in Argentina.

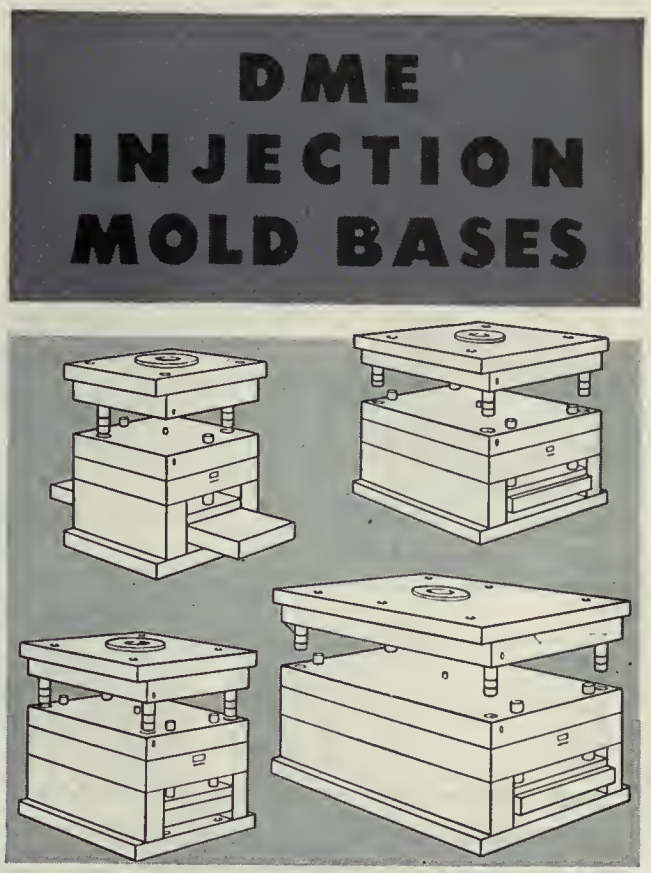
In Chile the only native production stems from a small supply of casein. Several firms manufacture plastics products from imported materials. The greatest use of plastics products has hitherto been in industrial installations. In Colombia the demand is vigorous and the production very limited. Only one firm manufactures plastic materials. Most of the finished products available are those usually found in our 5- and 10-cent stores. There is a great market for machinery and materials.

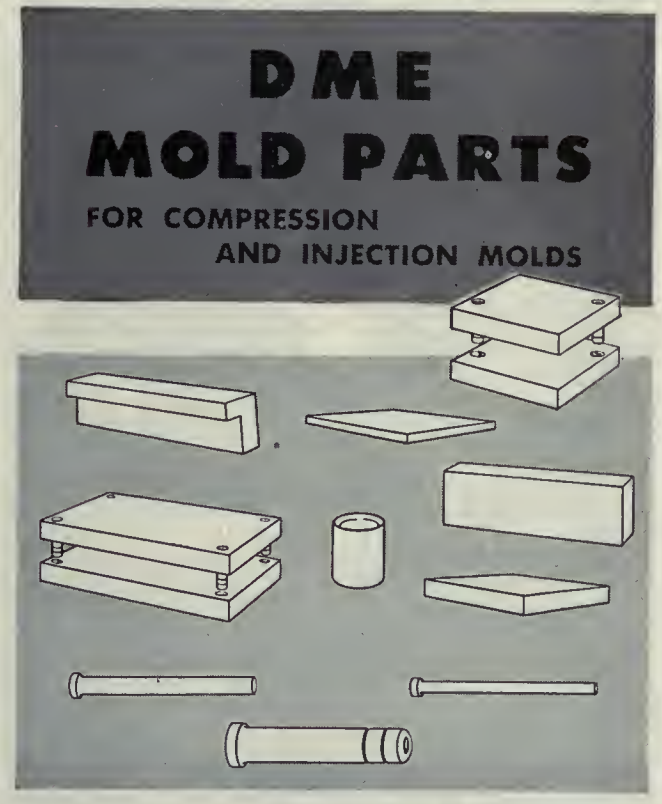
Mexico is reported as a potential market of great possibilities. It has considerable plant facilities. Its casein comes almost wholly from Argentina. When war restrictions are lifted, the Government explorers appear to think Mexico will be a live market for materials and machinery. Peru makes no plastics materials but has a very small industry which produces finished goods. It has been inured to the cheap German materials and products. The industry uses only compression machinery, but has sought to obtain injection equipment. Its present supply of plastics is wholly American, and the market could be maintained if not neglected after the war.

Uruguay has a small but very active and expanding industry which sprang from the German base. Casein is the chief material, obtainable in Uruguay in large quantities. It sells a large part of its plastic finished products to Argentina. Venezuela imports all materials. Its finished products are mostly small. It wants more American materials and machinery. Cuba buys all plastic materials from the U. S. It will want much more. No manufacturing is done in Ecuador, Costa Rica, and Paraguay, but they import small quantities of materials.

The Status Quo

Details of the manpower problem and the Nelson civilian production program are contradictory and confused, but the over-all picture is clear. Army is genuinely short of some badly needed equipment and munitions. Most of the needed supplies are either new, or have been adjusted in the light of the shifting experiences in war. Army also very genuinely is opposed to releasing any production facilities for unneeded civilian purposes. It thinks the war is won, but the enemy has not laid down arms and Army properly holds the war is not actually won until the enemy quits. Army not only wants huge reserves of materials and facilities, but it wants those facilities available for instant use so long as the war continues. It wishes to continue to be in the position to drown the enemy in a tidal wave of materials and potentials, and to save men on the battlefronts. And it wishes to put a stop to the psychology that in one month has caused over 100,000 workers to rush home from the Pacific Coast to get peacetime jobs before the veterans get back. END





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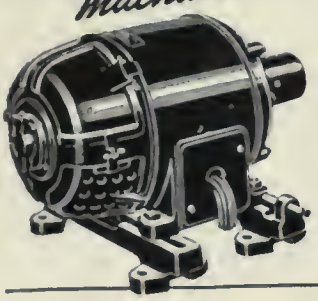

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association activities

National Plywood Distributors

Compregnated wood, was described as lighter than wood and stronger than steel in a talk by Alexander Bukolt, Pluswood, Inc., Oshkosh, Wis., at the third annual meeting of the National Plywood Distributors Association in Chicago.

Treatment of wood by chemico-mechanical processes can produce a plywood that can compete with plastics and challenge metals, Bukolt stated. This new material promises to change completely the pace of the post-war plywood business, he said. It is applicable and adaptable to gear stock, fine furniture, floors, store fronts and numerous other uses.

Officers and three new members of the board of directors for the coming year were elected. The new officers are Hal Keely, Hal Keely Plywood Co., Pittsburgh, president; Geo. L. Waetjen, Milwaukee Plywood Co., Milwaukee, vice-president; Louis G. Riecke, Tulane Hardwood Lumber Co., New Orleans, secretary; James A. Roland, Fry-Fulton Lumber Co., St. Louis, treasurer; R. M. McClure, Washington, D. C., managing director; and A. E. Pye, Chicago, associate director.

Three incoming members were elected to the board of directors—Carl Crosby, New England Panel Co., Everett, Mass., to represent the Atlantic coast area; Kenneth J. Shipp, California Builders Supply Co., Oakland and Sacramento, to represent the southern Pacific coast states, and Adolph E. Wanke, Wanke Panel Co., Portland, for the Pacific northwest. In addition to these three newly elected members, Hal Keely, who had served as vice-president, was re-elected to the board.

SPI 1944-45 Directory

Questionnaires have been mailed to all SPI company and professional members for the 1944-45 directory, which is to contain new chapters on The Plastics Pioneers. An expanded product index is also to be included as well as a complete listing of membership; a section devoted to professional members of the society with a short biographical sketch indicating the type of work in which the member specializes.

Cellulose Plastics

In a recent address before the Joint Plastics-Douglas Fir Plywood Association at Seattle, J. K. Speicher of the Cellulose Products Department, Hercules Powder Co., spoke on "Recent Advances in Cellulose Plastics."

Cellulose plastics, Speicher said, under a sustained load, will all tend to give some cold flow, particularly if the temperature is a little high. Methods have been sought to reinforce these plastics in some way to reduce cold flow and further improve impact strength if possible. This objective has been accomplished to a considerable extent, Speicher continued, by *laminating with fabric.* Laminates made of cotton fabric and cellulose acetate or ethyl cellulose plastic have remarkable shock resistance and hold their shape rather well under fairly adverse conditions. Such laminates can be made and used as flat sheets, they can be made as flat sheets and then subsequently formed and drawn hot, or they can be built up around a form or mandrel.

The fact that flat sheets of thermoplastic laminate can be drawn is of particular interest since it offers a possibility of manufacturing the laminates in a few plants best equipped for the process, and shipping or fabricating them in numerous smaller plants where the finished products are being made. Deep draws and other forming operations can be made with very simple equipment. The plastic when heated forms its own adhesive so that sections can be joined by heat, or if desired a solvent-sealing process may be used.

How to prevent inflation in one easy lesson

Put that money back in your pocket!

When a lot of people want the same thing, its price goes up.

Americans have more money today—much more—than there are things to buy with it.

So every big or little thing you buy—that you can possibly do without—cuts supplies and bids prices up on what is left.

Rising prices spell inflation. And every inflation has been followed by a cruel and bitter depression . . . men out of work, homes lost, families suffering.

We don't want inflation: we don't want another depression.

4 THINGS TO DO to keep prices down and help avoid another depression

1. *Don't* buy a thing you can do without.
2. *Never* pay more than the ceiling price. Always give stamps for rationed goods.
3. *Don't* take advantage of war conditions to fight for more money for yourself or goods you sell.
4. *Save.* Buy and hold all the War Bonds you can afford—to help pay for the war and insure your future. Keep up your insurance.

HELP US KEEP PRICES DOWN

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

INDUSTRY HIGHLIGHTS

Electric Junction Box

The Glenn L. Martin Co.
Baltimore, Md.

A plastic electric junction box which is considerably lighter and far easier to assemble and maintain than the standard aluminum alloy boxes now in use will soon make its appearance in forthcoming Glenn L. Martin Planes. (See Photo)

The new box reverses present practice by using a flat plate as the main section to which installations and wiring are attached, and a molded cover of transparent plastic. With the type now in use, all installations are made in the box proper where they are far less accessible during assembly and maintenance than on the new unobstructed flat surface.

Another time-saving improvement is the sensitizing of the base plate and the reproduction thereon by a photographic process of the wire flow diagram. This simplifies drilling, assembly and wiring of the boxes in the factory and provides a permanent record for the use of field service men.

The transparency of the cover adds still further to the man-hour savings which the new type box will make possible. With the old-type metal box now in use in the center wing section of the PBM-3 *Mariner*, it is necessary to remove and replace the cover 23 times for visual inspections between the original installation and the turning of the airplane over to ground test. This operation is repeated countless additional times in the field, yet with the transparent cover can be completely eliminated.

Weight as well as time savings with the new box will be considerable, ranging as high as 33% per box depending on the type of box and the material from which the base is made. While present plans call for introducing the new design only

in the radio direction finder junction box, the design is equally applicable to all other junction boxes in the airplane. In the case of a plane similar to the PBM-3 *Mariner*, which uses approximately 100 boxes in its various electrical systems, this would result in a net weight saving of 35-40 lb as well as a marked reduction in material and manufacturing costs. Even greater savings are possible in larger airplanes such as the JRM-1 *Mars*.

●

The B. F. Goodrich Company's chemical division, recently established, is now located in Cleveland, it was announced by W. S. Richardson, division general manager. The division is housed in the Rose building, Prospect Avenue and East Ninth Street.

Distribution and technical service to processors of the company's line of *Geon* vinyl resins, rubber chemicals, synthetic rubbers and reclaim rubbers in raw material form will be handled from the Cleveland office, Richardson said. A development laboratory is included.

Executives and other personnel who will staff the offices have formerly been stationed in the company's general offices in Akron.

The 18,000 sq ft of the new location have been remodeled into a series of glass block offices and a modern laboratory in which chemicals and plastics manufactured by the company for war uses will be developed, tested and demonstrated.

●

Hercules Powder Co. announces plans for expansion of its ethyl cellulose plant at Hopewell, Va., to meet increased ammunition demands from the Army and Navy.

The plant producing the cellulose material for ammunition, aircraft, and other uses, will be increased over 60% of present capacity.

Military uses for the ethyl cellulose produced at the plant include rocket assemblies, shell ignitors, other ammunition parts, aircraft parts, lacquers, flashlights, plastic wrapping, known as "plastic peel" for spare parts for aircraft, autos, trucks, and other machinery used at the front, and other uses which are secret.

Included in the expansion will be construction of an ethyl chloride production unit for the conversion of by-product materials of the ethyl cellulose plant.

The ethyl cellulose requirements of the Army and Navy have lately been revised upward by the sharp increases in ammunition production ordered by the War Department, increases of "several hundred %" over the already high production levels.

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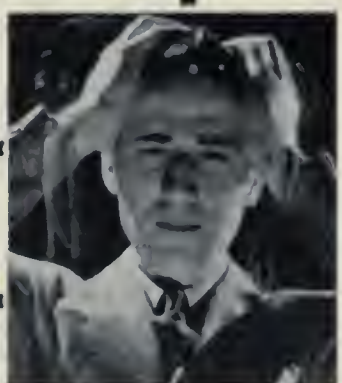

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Patent rights to a technique for three-dimensional design of plastic materials have been granted to Gits Molding Corp. of Chicago.

The process makes possible unusual design and multiple-color effects, through the "sealing in" of a design into transparent molded pieces. Termed *Crystal Seal*, the process is covered by patent No. 2,354,857 with 15 claims. Products to which it can be applied include name plates, dials, trim, insignia, counter displays, trade marks, medallions, emblems, signs, escutcheons, plaques, buttons, ornaments, jewelry, stationary and desk products, game pieces, handles, knobs, drawer pulls, door plates and many technical products.

•

Offices of the eastern division of Continental Can Co. have been moved from 100 E. 42nd St., New York, to the eighth floor of the Chanin Building, 122 E. 42nd St., according to T. C. Fogarty, general sales manager.

•

Wheeling Stamping Co., manufacturers of malleable tubes, has installed a new plastics division for the production of caps for its tubes, used as containers for toothpaste, shaving cream and similar products. The plastic caps will replace those formerly made of metal, being of superior quality, according to the company.

•

Post-war X-ray units will be displayed by Kelley-Koett Manufacturing Co., Covington, Ky., at a series of meetings during late Summer and early Fall, according to announcement by A. H. Feibel, president. These will include industrial types of machines.

•

Failure of the synthetic rubber industry to continue granting licenses after the war will result in anti-trust litigation against it, Attorney-General Francis Biddle recently warned. He pointed out that the 20-odd companies in the wartime synthetic rubber patent pool are not now required by their agreements to license future applicants. He charged that specialty rubbers are subject to monopoly practices and are not covered by existing pooling arrangements.

•

A simple, quick test of glue for permanent waterproofness is needed by the plywood industry, according to N. S. Perkins, technical director of the Douglas Fir Plywood Association, in a talk before the recent Plastics-Plywood Conference held by the group in Seattle.

It is important, he pointed out, that the industry not become over-confident about the fallibility of present waterproof tests. It should follow products through, verifying their behavior in the hands of the final consumer.

He indicated a need for a durable exterior paint that will not show hair-checks in post-war housing plywoods, probably a paint with an elastic film and a rubber base.

•

The Eccles and Davies Machinery Co., Inc., Los Angeles, has been appointed southern California representative of Lester-Phoenix, Inc., of Cleveland, to handle the complete line of Lester-Phoenix high-pressure die casting machines and Lester injection molding machines.

•

The National Motor Bearing Company, Inc., Redwood City, Cal., has announced the purchase of the Arrowhead Rubber Co., Los Angeles. Through this transaction, Arrowhead becomes a wholly owned subsidiary of National.

Arrowhead is a sizeable concern fully equipped for the manufacture of synthetic rubber parts and the purchase insures a steady supply of synthetic rubber flanges.

•

Machinery Sales Co. has been appointed representative in California, Arizona and Nevada of Chemaco Corp., subsidiary of Manufacturers Chemical Corp., of Berkeley Heights, N. J., producers of *Chemaco* thermoplastic molding materials, such as cellulose acetate, ethyl cellulose, polystyrene and vinyl compounds.

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NALCO

PEOPLE

J. Harry DuBois has been appointed executive engineer of the Shaw Insulator Co., it was announced by Frank H. Shaw, president.

Mr. DuBois was formerly commercial engineer for the plastics division of General Electric and is author of the textbook "Plastics." He graduated from the University of Minnesota in electrical and mechanical engineering and studied law at Kent College. He is technical consultant and member of the advisory board of the American School, Chicago, and a member of the S.P.I., S.P.E. and Plastics Pioneer.

J. H. DuBois

K. R. Van Tassel

C. A. Powel

K. R. Van Tassel has been appointed manager of the Industrial Control Division of General Electric's Industrial Divisions, it has been announced by J. E. N. Hume, commercial vice president. Mr. Van Tassel succeeds George R. Prout, recently appointed manager of the Company's Air Conditioning and Refrigeration Division of the Appliance and Merchandise Department.

●

Charles A. Powel, manager of Headquarters Engineering of the Westinghouse Electric and Manufacturing Company, was elected president of the American Institute of Electrical Engineers for the year beginning August, 1944.

The President's badge was presented to Mr. Powel at ceremonies opening the Institute's Summer Technical Meeting recently. A former vice president and director of the AIEE and noted as a diagnostician of power plant problems, Mr. Powel will succeed Dr. Nevin E. Funk, Vice President of the Philadelphia Electric Co.

●

Ben W. Rau, sales engineer, and **Harry F. Slottag,** production manager, have been admitted into partnership by G. Felsenthal & Sons. They will continue in their present capacities.

●

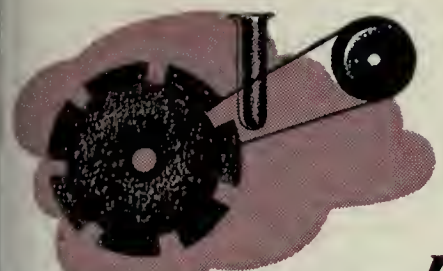
William H. Hunt has been appointed manager of the Detroit branch warehouse of United States Plywood Corp., succeeding the late J. C. Dorman.

A graduate of River Falls State College, Wis., Mr. Hunt entered the employ of Algoma Plywood & Veneer Co., now a U. S. Plywood subsidiary in 1935. In 1938 he was appointed assistant to Clay Wilcox, vice-president, two years later was named branch manager of the Cleveland office, and in 1942 assigned back to the Algoma plant as assistant general manager and sales manager.

●

Walter P. Konrad has been appointed branch manager of the phosphate division sales department, Monsanto Chemical Co., Chicago, it was announced by Robert S. Weatherly, general sales manager of the phosphate division.

Mr. Konrad graduated from Indiana University in 1922. In 1925 he joined the sales force of the Provident Chemical Co., a property of Swann Chemical Corp., which was absorbed by Monsanto in 1935. Since that time he has been in the phosphate sales group in St. Louis.



PROBLEMS in *plastics*

Problems and questions may be submitted to this department for answering by the technical editors or specialists in the industry.

Has any consideration been given to the possibility of making plastic objectives and eye-pieces for telescopes? It would seem possible to make a press or mold that could make many of a given size, instead of each having to be built up separately. *A. T. W., Riverside, Cal.*

The problem of making lenses for microscopes and telescopes out of plastics has undoubtedly received consideration. There is no available record, however, of such attempts. The fundamental objection is that plastics are too soft and therefore too easily scratched.

* * *

In my shop I have jig saws, band saws, table saws, lathes, grinders, drill presses, etc., and I would like to take sheets, strips, or rods of plastics, and heat and bend them into certain shapes, and then glue or weld them into novelties of some kind. What are your suggestions? *H. M., Dallas, Tex.*

Certain types of plastics can be machined with the equipment you enumerate, as pointed out in the article Machining Laminates *in this issue. However, it should be understood that the nature of plastics makes it possible to mold a large proportion of products to their final shape without need for extensive machining.*

* * *

We are manufacturers primarily of innerspring mattresses and upholstered box springs. We are wondering if your publication has any information as to whether anyone in the plastics industry is making, experimenting or producing a plastic upholstering spring. *R. E. R., Chicago, Ill.*

It is our opinion that you will find no one in the plastics industry who is even experimenting in the production of a plastic upholstering spring. Plastics materials up to now, just do not possess that type of elasticity. However, perhaps the publication of your query in this column will elicit information in this direction unknown to us.

* * *

After the war I wish to change from news reporting to industrial writing, specializing in plastics. I should like to know what is needed as a background to this field. I have had seven years in general reporting; reviewed chemistry and economics at college recently, and am taking a correspondence course in plastics at present. *Sgt. R. G., Camp Rucker, Ala.*

Our general reply, in answering your query, would be that the most important qualification for such a writer would be a knowledge of plastics materials and the methods employed in working them. Proceeding in a more detailed manner on this recommendation, it would be advisable for you to read such books as Industrial Plastics *by Simonds;* Handbook of Plastics *by Simonds and Ellis, to become a regular reader of authentic, up-to-date periodicals, and then spend six months to a year in the plant of some company specializing in the general molding of plastics. By this time, you ought to be fairly well prepared to do reporting work on the subject of plastics. This may appear to be an extensive background, but it should repay you, as the plastics industry has a real need for skilled authors and news reporters.*

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Machining Laminates

(*Continued from page* 21)

less than 1½ times the diameter of the rivet should be avoided; they are poor structurally and are likely to cause splitting. Holes for rivets should be drilled slightly larger than for metal. A great deal depends on the density of the laminated phenolic. It is wise to experiment with the size drill to be used before setting up shop practices. The rivet should push into the hole by hand; or, where conditions are ideal (such as ample edge clearance) should be a light drive fit. Length of rivet to provide a proper No. 2 head can give a lot of trouble. Naturally, the greater the hole is oversize, the more the rivet shank will swell in upsetting and, therefore, the longer the rivet should be. A general guide is to have 1½ times the diameter of rivet extending beyond the material to be riveted. To assure good riveting, the phenolic material must be well-laminated and free from gum pockets. Laminates that are too dry will cause splitting, regardless of the skill of the riveter.

In our own fabricating plant, it is our practice to design riveted joints so that there is bearing all along the shank, since the great advantage of riveted phenolic material comes from the swelling of the rivet into the material, permitting a tighter joint than with riveted metal. We have been speaking all along of solid aluminum rivets. We do not recommend vibrating a harder metal in laminated phenolics. If other metals such as steel or brass must be used, either spinning solid shanks or using tubular or bifurcated rivets is the best procedure.

Painting

Paint may be applied to laminated phenolics by spraying, dipping or brushing. Best results are obtained from the use of a phenolic-base synthetic lacquer, baked at temperatures recommended by the paint manufacturer, but in no case over 250° F. On sanded or machine finished, such as ground-to-size rods and tubes, sheets that have been sanded to tolerances, or machined specialties, no preparation other than cleaning is necessary before painting. In most cases, the thinner used to reduce the paint makes a satisfactory cleaning agent, if simply wiped on with a clean cloth.

On molded surfaces with a highly glazed finish, or sheets pressed between plates, the phenolic laminate *must* be sanded lightly before painting. So far as we know, there is no primer or finishing coat which will adhere well to phenolic surfaces as they come from the mold. Adhesion is good on molded phenolic surfaces when the finish is baked, although it is not so good as on machined surfaces. If pieces must be air-dried, they should hang at least 24 hr before handling, unless special quick-drying finishes are used. Painted laminated phenolics are affected hygroscopically in direct proportion to the hygroscopic characteristics of the finish. Zinc chromate primer and certain commercial sealers have been found to lower the water absorption of exposed edges of pressed or molded laminates.

Screwing

Threads can be tapped or machined in plastic materials to accommodate machine screws. The National Coarse series of threads is to be preferred over the National Fine series. The tension or "pull-out" strength of a threaded hole can be determined from the formula $P = k\pi dlf_s$ where

f_s = average flatwise shear strength of the material
l = length of screw or bolt threaded into the hole
d = outside diameter of threads
k = an empirical factor depending on the plastic

On grade C material k probably lies between 0.55 and 0.70.

When a tensile load is applied to a screw in a plastic laminate, the elongation of the screw under the load tends to delaminate the sheet. Failure, therefore, may occur as a result of delamination rather than shear. Where possible, a through bolt and nut is preferable to a threaded hole. Self-tapping screws or drive screws provide a satisfactory threaded attachment and have the advantage of eliminating the tapping operation and of providing an absolute fit, without clearance.

Conclusion

Since this article deals only with the highlights of the most common operations used in fabricating laminated plastics, it should be at once apparent that this is no field for the novice. As in so many other things the only really satisfactory way to learn is by doing. In this case, that involves the expenditure of considerable money and time which might better be saved by entrusting fabricating operations to one who is thoroughly familiar with the behavior and characteristics of the product and who is, in most cases, already tooled up for fabricating. Moreover, such manufacturers are constantly discovering new and better ways to fabricate phenolics, such as the use of post-forming fibre, which we call Phenolastic Fibre. This new development has great possibilities, for it makes possible the forming of many intricate shapes with no more equipment than a set of wooden molds and the necessary equipment to reheat the plastic—plus the all-important know-how. END

Models Before Molds
(*Continued from page* 17)

pends largely on completion time. Since the model is of plastic, a far more machinable material than hard steel alloy of which molds are usually made, it can be worked with greater facility and speed (Fig. 4). Even where the mold has a single cavity, there is a vast difference in completion time between it and a model of the same specifications.

Fig. 7. Phase in making "Lumarith" model of liquid dispenser measuring chamber—machining. Followed by hand-grinding

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Fig. 8. "Plexiglas" demonstrator-model housing for a contactor relay mounted next to actual steel unit for comparison

The difference becomes more marked where a mold contains a number of duplicated cavities for, in this case, since only one model is required regardless of the number of mold cavities, the disparity in cost between model and mold becomes multiplied. To some extent, the model tends to cut the completion time of the mold itself, because the model provides an exact idea of the finished job and helps in designing the mold.

While we have analyzed plastic models by function and have developed classifications for them, that does not mean that each of the three types of model is used only for its individual purpose by an individual firm. The fact is that all three types may be in simultaneous use by one firm. This is particularly true in large concerns that market, or both manufacture and market, molded plastic products. With these firms the line of demarcation between the development model and the pre-mold model often tends to fade. The requirements are so precise and adherence to specifications is so exact for both, that there may be absolutely no difference between the two. It is simply that one is used for experimentation, testing and refinement of design, while the other is used as a recheck against the final blue-prints and as a three-dimensional guide piece for the mold-maker. If the development model has passed every test without alteration, and if its design is decided upon as the final one for the molded product, the development model may automatically become the pre-mold model. END

Plastics in Quality Jewelry

(*Continued from page* 34)

It now turns out ornaments and jewelry which will sell to the consumer for $3-$5. Its buttons will retail at $1 and $1.50, while pocketbook handles, zipper pulls and frames come in a price range of 25c to $15, being fitted to pocketbooks retailing at from 98c to $60.

Basically, all the items considered here are made from *Lucite* methyl methacrylate, the patterns being formed by undercutting. At the same time, these fine incisions vary the clear transparency of the material, giving the effect of shading comparable to the lights and darks of a charcoal or pencil drawing.

The color effects are obtained in various ways. The red body of the butterfly illustrated is made of red *Catalin*.

The spots and plaid lines and bows on the animals are of aniline dyes or enamels applied by hand, while the animal eyes are of painted glass. Some sets of pins are decorated with rhinestones, and bits of painted leather are occasionally used. The buttons illustrated are either merely undercut or are undercut and painted over the pattern.

The process of manufacture begins with the small acrylic (or *Catalin*) sheets, which are the only ones now available for non-military purposes. A series of patterns is superimposed on the sheet and the forms are roughly jigged out. The carver then takes each piece in hand and executes the undercutting shown on the design. With a flat piece, ashing and polishing follow. If it is to be shaped into curves in more than one plane, the piece must be heated in an oven to about 350° F. until it is completely pliable. After the desired form is imparted to it, the object is placed into cold water to set. Then ashing and polishing follow drying.

Painting, and assembly of the other decorative elements and the pins (where there are pins) complete the job.

Although there is nothing in this procedure which is unique with Hoffman, the method has given something new to its product; namely, is the intangibles of taste and a superior sense of design.

Trends in Post-War Design

(*Continued from page* 25)

serious providing definite basic rules are adhered to.

First, it is essential to design for plastics and not to convert plastics to other less favorable designs, namely, aluminum sand or die castings, magnesium castings or steel stampings.

Secondly, avoid at all cost the temptation to employ resinous materials in structural application subjected to critical loads, unless static tests have proven beyond a reasonable doubt that plastics are strong or durable enough to warrant consideration. Plastics, unlike other materials, have very few precedents which can be relied upon to measure their serviceability in terms of permanency, except in standard, acceptable uses.

Finally, in order to insure quality control conducive to a lasting program, select applications wherein the advantages possessed by plastics and not by other competitive products can be utilized to the fullest extent.

The rules just stated are neither unreasonable nor difficult to follow and have been practiced successfully on more than one occasion. For example, there is a prevailing knowledge that plastics are exceptionally brittle at normal room temperatures and lower. This factor alone has accounted for much opinionated argument against their use in items, which, if designed properly, might be served well by plastics.

If the part under consideration is exposed to repeated impact forces, the chances are that it would be unwise to resort to a substance as hard and unyielding as the thermosetting and to a lesser degree the rigid thermoplastic classes of materials.

At low temperatures, even the soft elastic plastics become susceptible to brittleness and shatter readily if struck too hard a blow. However, if the same part is exposed to a static load or mild vibrational forces, or an occasional shock load which may be expected through ordinary handling, the decision to use plastics rests with the good judgment of the engineer. His judgment will probably be governed by the section modulus, the strength, bulk factor and weight. In other words, as compared to an aluminum or magnesium part of fixed sections, what volume of plastics will produce satisfactory rigidity and ample strength at less weight and cost? A reduction in

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Noted Contributors

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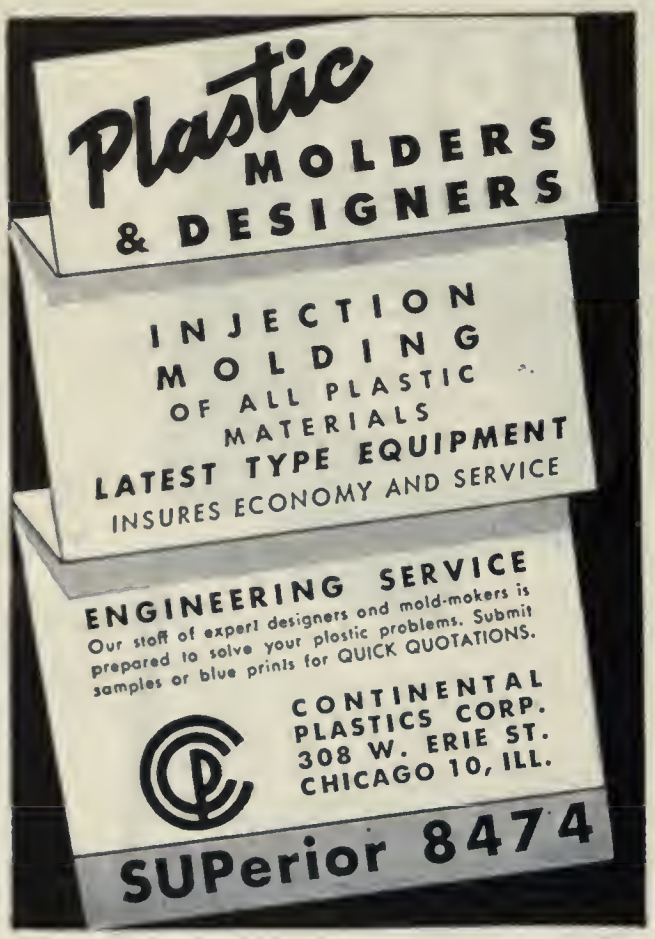

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weight and cost for equal performance will usually justify the choice of plastics in preference to a heavier, less efficient metal counterpart.

In competition with the light alloy metals, the higher cost of plastic materials constitutes a handicap. While this may not be particularly disturbing at the moment, in the light of the present demand for production, during the post-war years it probably will become insistently serious. Now, judging from various reports, plastic items, with some exceptions, cost more than metal counterparts. The exceptions, of course, consist of properly designed parts utilizing all advantages that can be obtained from the properties of plastics and production methods. The last is important. A recent survey and cost analysis of plastic parts employed in one of the North American Aviation airplanes disclosed a saving in cost over that of the same number of metal parts.

Almost in every case, the cost of the plastic material was considerably higher. From a breakdown of the production operations to manufacture and finish these parts, the metal operations ran higher than plastic. *Thus, in the total cost it was found that the metal machining cost was all out of proportion to the material and production cost. Hence, this more than compensated for the difference in material cost to give plastics a slight edge in total cost.*

However, one cannot accept this as sufficient reason to ignore the subject of material costs in the future. Furthermore, it is not safe to depend too much upon a positive price drop of plastic materials after the war; for that of aluminum, magnesium, steel and wood will drop likewise. The latter materials more than likely will reduce faster and farther, in view of the fact that tremendous production facilities and consumer markets are already established for these.

Prospective Uses of Plastics

One should hesitate to forecast the post-war trends of plastics with any degree of assurance. Although the possibilities appear to be numerous, it is yet too early to become unduly enthusiastic about the future. Potentially, plastics in various formulations have unusual and no doubt undiscovered capacities for rendering useful services if controlled and directed accordingly. For years, the bulk of all plastics produced was consumed by the electrical and radio industries. In this capacity, plastics, particularly the thermosetting type, has become indispensable because of its superior electrical properties. No other product will do as well. In the last few years, the thermoplastic group of resins, because of their flow characteristics and adaptability to injection and extrusion molding machines, made considerable progress in the novelty and so-called "gadget" field. Here the color combinations obtainable with the less rigid plastics offered a tremendous advantage over the colorless or somewhat drab plastics and other materials which required surface finishes.

Prior to the present world wide conflict, plastic products in all shapes, forms and colors began to make rapid appearances in industry and in commercial channels. As a matter of fact, the transformation was so rapid that few in the plastic industry could keep pace with events, let alone the layman who had barely become acquainted with the generic term and seldom could recognize a plastic when he saw it. Therefore, the indication of the pre-war trends, as far as is known, was never definite enough to justify an accurate prediction of future permanency. Some of the prewar items failed to satisfy expectations, subsequently, grew to fester public opinion. Others were good applications and most were commonly accepted as satisfactory.

Properties of plastics which lend themselves to future prospective applications will be discussed briefly. Assuming that the post-war consumer market will be of the same pattern as that before this war, the use of resins will be confined largely to four fields of endeavor; namely, novelties, luxuries, decorations and engineering.

In the first case, molding compounds have a natural bent for producing smooth, polished and colorful items dear to the novelty trades. Here, competition with other products will likely depend more upon beauty and originality of design than upon cost. Sheet, tube and rod materials such as clear or dyed acrylics and perhaps cast phenolic will also participate actively in novelties, but probably not in direct competition with the molded products. Larger parts more suited to fabricating techniques tend to be more attractive to sheet material fabricators, whereas, smaller compact items needed in quantities applicable to the production capacity of molding machines are more to the liking of the molders.

The luxury line is more demanding of the serviceable properties of plastics than is the novelty trade. Based upon price alone, plastics, in view of the higher cost of basic raw materials, must contribute more to the efficiency of operation than do the light alloy metals or others. Often times when weight is a primary factor, these materials serve better than metals because of their low specific gravity. Resiliency is another important property of plastics which may be used advantageously in certain functions. Better corrosion resistance and weathering stability can be a deciding factor in the selection of plastics over cloth, leather or wood products.

The flexibility of laminating materials has helped to make the decorative designer's job much easier. The decorative materials serve not only to grace pieces of furniture and wall panels with artistic configurations and colors pleasing to the eye, but they possess other durable properties as well. To eliminate cigarette burns and liquid stains, which mar the surfaces of conventional wood or metal tables, a thin layer of metallic foil is incorporated in and near the uppermost surface of decorative laminates. In addition, a surface coat of transparent urea formaldehyde resin offers resistance to abrasion seldom equaled by a wood or painted surface. All of these contribute to the usefulness of decorative materials in the post-war period and it would not be beyond the realm of imagination to conceive of prolific application in all modes of transportation, residential and office buildings and many places of public gathering.

Engineering

The engineering phase of plastics is more difficult to define. When dealing with components of machines and structures, stresses and loads are introduced which require technical knowledge of the material properties contemplated for the proposed design. Since the strength and modulus of elasticity are usually too low or non-uniform for primary structural purposes, it is considered best to apply plastic in non-structural components, at least for the present.

In non-structural parts, working in conjunction with primary or secondary structural assemblies, plastics have proven to be good, sound engineering materials. When one stops to consider the number of low stressed parts which make up a structural assembly, whether it is an airplane, automobile or industrial machine, it is noted the loss of efficiency, in view of the fact that most or all of these parts are made up of heavy, high strength alloys.

In the post-war era, engineers will be more cognizant of this fact in view of the economic readjustment which is certain to take place and the tendency will be to use all

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types of material, each where it can do a job better than the other. Hence, plastics having made an impressive start in the war effort are certain to take an important position in that program.

Among items to which plastics could be applied are the following:

Novelties—shoe racks, Venetian blinds (slats—phenolic sheet), clock cases, flower vases, book ends, humidor and pipe rack, drinking glasses, pitchers, card tables and score pad container.

Housing—floor surfaces (plastic tile, artificial hardwood, designs), roof covering (plastic slabs, shingles), wall covering (decorative panels), cornice, molds, coves, gutters, down spout, roof flashing, vents, louvres, screens, bay window hood, window sills and trims, window, translucent and plastic sash, insulation and sound-deadening material between floor and ceiling joists and partitions, hand rails and bannisters, wall units for baths, lavatory, tubs and bowls, medicine cabinets, pullman units, towel bars, plastic doors—knobs—hand plates, kitchen wall units, sink and cabinet units, lighting fixtures, housing, wardrobe units, bars, racks, air ducts, address numbers and mail boxes.

Air Transportation—flooring, seats, windows and trims, control pedestal housing, panels and liners, light brackets and shades, passenger seats, seat covers, decorative wall panels, insulation, sound proofing, cigarette containers, magazine racks, compartment doors, sleeper berth arrangement, food heating cabinets, first aid kit and garbage disposal container, lavatory bowl, chemical toilet, cabinets, paper and towel containers, access doors, wing tips, wing tip light covers, wing-to-fuselage fairings, nacelle tail cones, fuel tanks, oil tanks, cable brackets, landing gear doors, ailerons and tabs, heating and ventilating ducts and elbows, rudder, elevator, tabs, fairings, surface control cable, brackets and housings, hydraulic valves, plungers, rings, hoses, brackets and supports, electrical junction boxes, wire protective covers and tubes, lamp brackets and housings, carburetor air ducts, radiator cooling ducts, control brackets and knobs.

Automotive—body, door, window garnish molding, trim panel, latch striker plate, alignment wedge plate, hardware, kickpad, escutcheons, sun shade, windshield garnish molding, wiper motor housing, wiper, fenders, hood, rear trunk door, fender pants, gas tank fender door, bumper, stone deflector panels, fender, stone deflector panels, rear window, garnish molding, Venetian blind, seat back, seat covers, seat trim panels, arm rest housings, dome light housing, dome light switch, tail light housing, head light housing, turn indicator light housing, parking light housings, license plate light housing, junction blocks, exterior grille, trim strips (fender, body, hood, trunk and hood handle housings), brake handle, engine controls, radio controls, hood latch, radio grille, black lighting of instruments, indirect lighting of instruments, engine air cleaner, oil filter, coil, generator, starter, voltage regulator housing, radio antenna housing, license plate trim, electrical clock, vanity mirror, direction signal control lever, wheel horn ring, wheel hub caps, white wall disk trim and battery retainer.

Automotive House Trailers—body construction, window moldings, door panels, trim strips, table tops, kitchen hardware, shelves, flooring, Venetian blinds, garbage disposal, interior trim, sink and ice box.

Buses—seat backs, luggage racks, window garnish moldings, hand rails, indirect lighting fixture, flooring, body panels, interior trim and window shades.

Household and Office Items—outdoor lawn, barbecue and sport furniture, kitchen table, corner seats and drain board tops, magazine racks, foot stools, lamp stands and shades, curtain and drapery rods, clothes hampers, shower

doors, utensil handles, measuring utensils, hot pads, clothes pins, clothes lines, clothes racks, wash board, canister sets, bread boxes and boards, ironing boards, cabinets for spices, food lockers, shelves, serving and hors d'oeuvre trays and liquor bar; beauty salon dye containers, manicuring tables, drier stands, racks, sterilizers, show cases, dispensers and atomizers; desk tops, cabinets, files, shelves and covers.

It must be pointed out that there are very few commodities, new or old, that haven't been tried in plastics. Therefore, this list is not necessarily original. The purpose in submitting a representative list of prospective application is two-fold: From such a list, one can obtain ideas for entirely new or related applications in some other field, or a possibility may be seen to expand the uses of these products in any given field. Furthermore, it is not intended to argue for or defend the selection of items shown. One cannot definitely say that a new application is better suited to plastics until all factors are known and the conditions previously stated have been satisfied.

Conclusion

The more one studies plastics, the more he becomes impressed with the unusual versatility of these materials. The ability to change character under various conditions of temperature and chemical action, instead of being a disadvantage as was formerly believed, actually gives the chemist, designer and engineer a flexibility not obtainable with other materials. Given time, research men will ultimately improve many of the limitations long associated with plastics. And with more time, everyone will recognize them for what they are, that is, a prolific group of materials each possessing excellent properties for specific accomplishments. Then it will be said that a type of material is functionally good or bad, as is the case with metals, when referring to aluminum, magnesium or steel in place of the generic term "Plastic" which covers a multitude of products. END

Welding Thermoplastics

(*Continued from page* 32)

found advisable to develop a comparatively simple technique for the determination of such field diagrams (Br. Pat. 555,196).

Instead of exploring the actual high frequency field this method makes use of an electrolytic substitution of the dielectric system. A bridge method is used to determine points of equal potential in electrolytic solutions the concentration of which is chosen in proportion to the dielectric factor of the actual plastic to be welded. As electrolytic conductivities can be substituted for dielectric conductivities, a true picture of the field distribution can be obtained in this way. This has been checked by exploring fields of simple shapes where the mathematical treatment is easy and where the experimental results were found to approach closely the theoretical figures.

The diagrams shown in Figs. 2 and 3 illustrate the results obtained with this "field plotting device." In Fig. 2 is shown a representation of a lap welding problem where two blocks of plastie are clamped between two flat electrodes. The pieces overlap, but not for the full width of the electrodes. Applying the arbitrary figures of 0 and 100% to the potentials of the two electrodes the intermediate lines of potential have been drawn and marked in per cent of the total potential. It ean be seen that a considerable distortion of the field has occurred. This is due to the fact that the sheets of plasties have a higher dielectric factor than air and, therefore, distort the original arrangement

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of the field. Symmetry has been preserved at the center of the set-up although the axis of symmetry is inclined towards the vertical. It can be seen that the lines of equal potential concentrate in certain places, and practical experience in welding has confirmed the fact that heating in these places is more pronounced than in the other parts of the material.

Fig. 3 shows a more elaborate design of a "T" weld where three electrodes are used, of which two are at the relative potentials 0 and 100% while the third is biased at 50% of the total potential. In addition, blocks of a material with a higher dielectric factor than air have been introduced as well as air gaps between two of the electrodes and the job to be welded. The field diagram in this case would have been difficult to approach on a purely mathematical basis as a considerable number of factors influence the shape of the equi-potential lines.

By carrying out simultaneous tests of actual high frequency welding with scale replicas of these diagrams, the heat distribution for a given arrangement of electrodes can be easily checked. This device has been of considerable help in carrying out welding operations with various plastics.

The high frequency welding technique for plastics is still in its infancy and a large number of "teething" troubles have to be overcome before it can reach the status of resistance welding of metals. A few facts should be mentioned which are essential for further progress in this field.

It has already been stated that the heating depends, among other things, on the physical properties of the plastics to be joined. It is therefore essential to keep a close check on these properties, particularly the dielectric factor and the loss factor of plastics in the course of their manufacture in order to obtain comparable results in the field of welding. It is to be hoped that attempts will be made by plastics manufacturers to control plastics to similar close specifications as is now the case with metals. END

Plastic Cements

(*Continued from page* 53)

pure aluminum, aluminum alloys, magnesium, steel, zinc cadmium, fibrous glass, cotton, rayon, other cellulosics, woods, natural and synthetic rubbers and several plastics. All of these, however, cannot be bonded by one process. It was found, for example, that a bond between glass and the synthetic rubber *Metlbond* failed when subjected to prolonged sunlight. This problem was solved by placing the plastic type of *Metlbond* next to the glass, then a layer of the synthetic rubber type was placed between the plastic-coated glass and the material to which it was being bonded.

The *Metlbonds* have made possible a number of other developments. One of the most promising has been a composite aluminum fibrous glass sheet in which one or more layers of high tensile strength fibrous glass are *Metlbonded* between two layers of aluminum. The resulting sheet has a higher modulus of elasticity (stiffness-factor) and superior tensile strength when compared with aluminum alloy on a weight basis. More important still, because of the excellent sound insulating properties of *Fiberglas*, the composite sheet when applied as skin to the fuselage of an airplane, results in a considerable reduction in drumming noise. This material has been applied on the fuselage of Consolidated Vultee's new commercial transport *Model 39* in the area of propeller rotation. Difficulty had been encountered with excessive noise and vibration due to the fact that the tips of inboard propellers are only 7⅜" from the fuselage. A "sandwich" of *Fiberglas* and Alclad bonded

by *Metlbond,* weighing less than aluminum plate of the same dimensions, dampened the vibrations and cut down excessive noise resulting from the proximity of the propeller tips.

Another development which has been made practical by an application of the *Metlbonds* has been the construction of plastic dies, jigs and fixtures. The economy of casting tools in plastic rather than machining them out of steel is obvious. However, in actual practice it was found that plastic tools were subject to breakage when handled in the shops. The amount of breakage was greatly reduced by *Metlbonding* thin steel sheets to the plastic surfaces.

The use of *Metlbonds* has simplified the problem of corrosion which arises when two dissimilar metals are fastened by the conventional methods. The presence of an electrolyte, such as salt water, with two different metals forms an electrochemical system which under certain conditions results in the corrosion of one of the metals and a resulting failure of the assembly.

The *Metlbonds,* when used to fasten unlike metals, serve as electrical insulators between the pieces and prevent corrosion. This property is of particular importance in the assembly of airplanes constructed of both aluminum and magnesium parts which, when assembled with rivets, are extremely susceptible to corrosion. In addition to preventing corrosion in joints between dissimilar metals, the *Metlbonds* are sufficiently flexible to allow for the variation in thermal expansion when two different materials are joined.

Metlbonds have been approved by the Army Air Forces for the assembly of many airplane parts. Although not released for use by other firms yet, they are being used in the plants of Consolidated Vultee in the production of many essential parts of combat aircraft. Research work continues constantly to develop improved *Metlbonds.* END

Lucite-Butacite

(*Continued from page 69*)

is increased. Maintaining the temperature of the interlayer may be accomplished by having the air temperature inside counterbalance that on the outside. This is modified by such factors as external air film coefficients, which are influenced by air velocity and atmospheric pressure. Internal air film coefficients are similarly influenced as in the use

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140° F (60° C)	2,400
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Elongation (%, average)	
60° F (155° C)	20.5
25° F (39° C)	1.6
-40° F (-40° C)	0.3
Flexural strength (psi, parallel to laminae)	
140° F (60° C)	500
32° F (0° C)	8,800
-76° F (-60° C)	16,000
Impact strength (ft-lb, Charpy)	
140° F (60° C)	4.6
32° F (0° C)	0.4
-76° F (-60° C)	0.4
Shearing strength (psi)	
140° F (60° C)	1,900
32° F (0° C)	3,700
-76° F (-60° C)	
Thermal conductivity	1.3 Btu/sq ft/hr/°F/in
Coefficient of linear thermal expansion	8 x 10-5 in/°C
Heat distortion ASTM D-648-41-T	63° C
Light transmission (visible region - %)	91-94
Haze (%)	2.6
Index of refraction	1.47
Specific gravity	1.132

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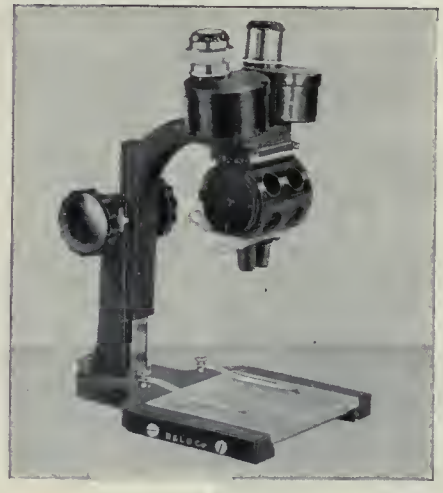

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of hot air blasts against the inside surface of an enclosure for defrosting. Even with interlayer temperature considerably lower than 0° F, however, the laminate is still superior to the unilaminar acrylic sheet.

Optimum Specifications

Good results have been obtained in pressurized firing tests with laminations composed of three layers of about equal thickness, with total thickness ranging from 0.4 to 0.625". Choice of thickness depends on depth of draw, temperature of interlayer, pressure and mounting.

In a deeply-drawn dome, for example, there will be more thinning out than in other shapes — as much as 40-60%. In the case of temperature of the interlayer, if this cannot be maintained reasonably high (0° to 10° C), thicker laminates should be used.

Choice of thickness of laminate is also governed by pressure differential. The highest pressure at which the laminated semi-cylinder 17" long and 22" in diameter did not rupture when shot with a .50 cal bullet was 8 psi for 0.3" thickness of lamination, 10 psi for 0.35" and 12 psi for 0.4". In all three tests, the temperature of the plastic was —22 to —40° F.

Installations

Installations are of three general types: The panel mount, either flush or offset, the semi-cylinder, and the dome mount, which may be stationary or mobile.

The stationary dome mount shown on page 68 is of the double-shear-strip type. When intended for mobile installations on a track, with closure tension applied through the wheel shafts, a different mounting is needed, with a pressure sealing plate.

The flanged type of dome mount (page 69) is not recommended for pressurized applications unless the load can be brought to bear tangent to the dome to eliminate excessive flexural stress. The off-set type is not suited to pressurized applications.

Cemented Joints

Various types of cemented joints are possible with the laminate. The butt type has an ultimate strength of 400 lb per linear in, or 1500 psi of *Lucite*. The average joint of this type breaks at about 3500 psi.

The tongue-and-groove type has an ultimate strength of 775 lb per linear in, or 3160 psi of *Lucite*, while the "T" rib has an ultimate strength of 775 lb per linear in, or 2800 psi of *Lucite*. The cement employed in obtaining these data, designated as H-94, when coming in contact with the butyral sheeting extracts plasticizer and thus reduces the strength of the joint. To prevent this, the interlayer should be routed away at the edge so that it does not contact the cemented inter-face. END

Metal Foil and Plastics

(*Continued from page 29*)

It is at this point that the consumer becomes somewhat confused. He receives a bulletin from the plastics manufacturer and wades through many columns of test reports, among which may be such properties as dielectric constants and optical rotation factors. These and other properties are most important to the physicist and the electrical engineer but mean little to the formulating or laminating chemist in the packaging field, for example, unless he is working on a product for electric insulation. There are, however, certain properties he must know, among which might be mentioned: Extensibility, dimensional stability, resistance to cold and heat, resistance to ageing and sun-

light, compatibility with other plastics, resins and plasticizers, and the degree of solubility in the countless solvents now on the market. These are only a few of the many properties he must know concerning a filamentary material or of a plastics coating. Having all of these factors at his command, he can draw up a chart of a theoretical material having properties needed for a certain wrapping, composed of a plastics sheet or coating most closely resembling the theoretical material desired. But if he finds no one material will answer all of his requirements, he solves his problem by producing a composite lamination having all the properties he desires.

Recent developments have advanced the frozen food industry tremendously and in this field aluminum plays another important part. While tests are still continuing, aluminum foil or better yet, aluminum foil laminated to a plastics sheet or paper, appears to act as an aid in quick freezing and as an insulator to prevent the transmission of heat to the frozen article.

The production of plastics must be increased many times if our post-war requirements are to be adequately provided for and, instead of replacing metal, wood, etc., they will increase their consumption because production and consumption of plastics depend upon these related materials. There will be no ethyl cellulose or phenolic gears made if there is no steel machinery to need them. The woman's hand bag may have a plastic handle, but it is likely to have a textile bag. The refrigerator may have a plastic outer casing but it will have a metal inner casing and a metal motor and compressor. Integrated functions such as these will provide a broad future for the continued expansion of plastics. END

Molders Cut Rejects With X-ray

(*Continued from page 60*)

plastic body. Such voids generally do not show enough contrast to be detectable fluoroscopically, and therefore radiography is employed. Some typical examples of void conditions are shown in Fig. 6, illustrating an end view radiograph in which there is a distribution of large voids around the periphery of the brass sleeve insert.

Figure 7 shows an enlargement of a radiograph of a molded phenolic piece, giving a good view of case-hardening or too-rapid curing. On the actual piece the difference between the surface region and the center was not appar-

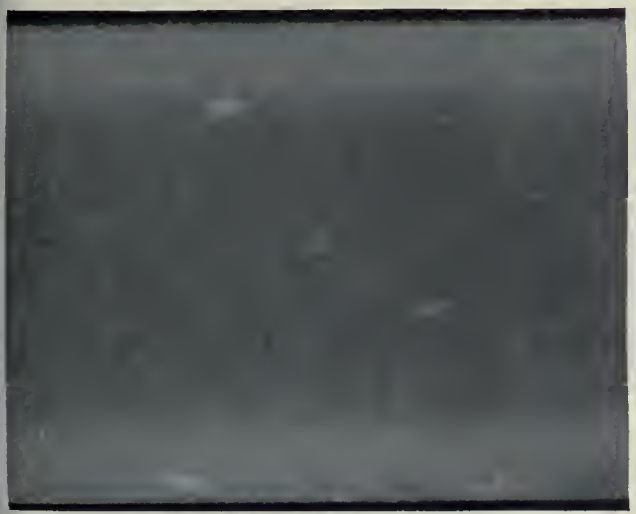

Fig. 8. A 5X enlargement of Fig. 7 for study of variation in porosity gradient from center to surface of specimen

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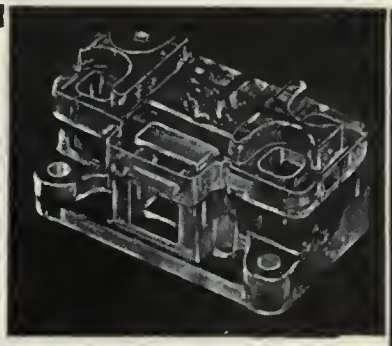

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Molders, Fabricators of all type plastics.

Fig. 9. By enlarging a radiograph of plastic with filler, the filler becomes clearly visible and density variations from center to surface of the specimen can be analyzed

ent. X-rays bring it out, however, because they are sensitive to changes in the density of a material.

A technique for investigating plastics that probably will be exploited in the future is the correlating of structure vs properties, similar to microstructure studies in metallurgy. Plastics are not amenable to ordinary photomicrographic technique because of the difficulty in preparing the surface to be inspected, and also because of its poor light reflecting properties. Magnification of fine grain radiographs of plastic materials, however, can furnish what may prove to be interesting structural details. A 5X magnification of Fig. 7 is shown in Fig. 8. A good study can be made of the density or porosity gradient from the center to the surface of the specimen.

Frequently new and interesting uses of X-rays in the plastics industry are discovered. One manufacturer inspects salvage material for stray metal particles before grinding to minimize blade damage on cutters. Another manufacturer checks the kinking of wires in multiple conductor cables after the product has undergone severe flexural tests. Thus, from the examples cited, it is readily apparent that X-ray has a definite role to play in the plastics field, now and after the war. END

Polyethylene

(*Continued from page* 43)

with thermodynamic concepts for crystalline materials, polyethylene begins to dissolve in a number of organic solvents at a temperature of 50° to 60° C.

In these early stages of the development of this plastic, it is difficult to state with assurance just what place it will ultimately occupy in the industrial picture. The extremely good electrical properties of polyethylene assures the resin a permanent place in the insulation field. The other unusual characteristics of polyethylene warrant consideration of this material for many applications entirely unrelated to electrical uses. As an example, injection molded polyethylene washers for cylinder valve packing are now outperforming the type of gaskets previously used. For the engineer and the plastics manufacturer, it will suffice that a new material with unusual properties is now available. Research, design, and experimentation will demonstrate the wide possible applications of polyethylene plastics, but large scale applications must await decreased wartime demands for use of the material as insulation on coaxial cables. END

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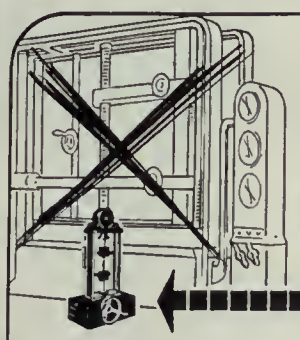

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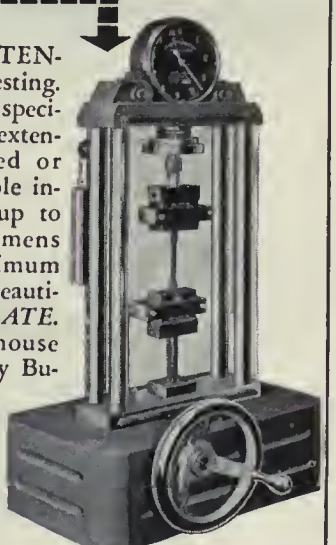

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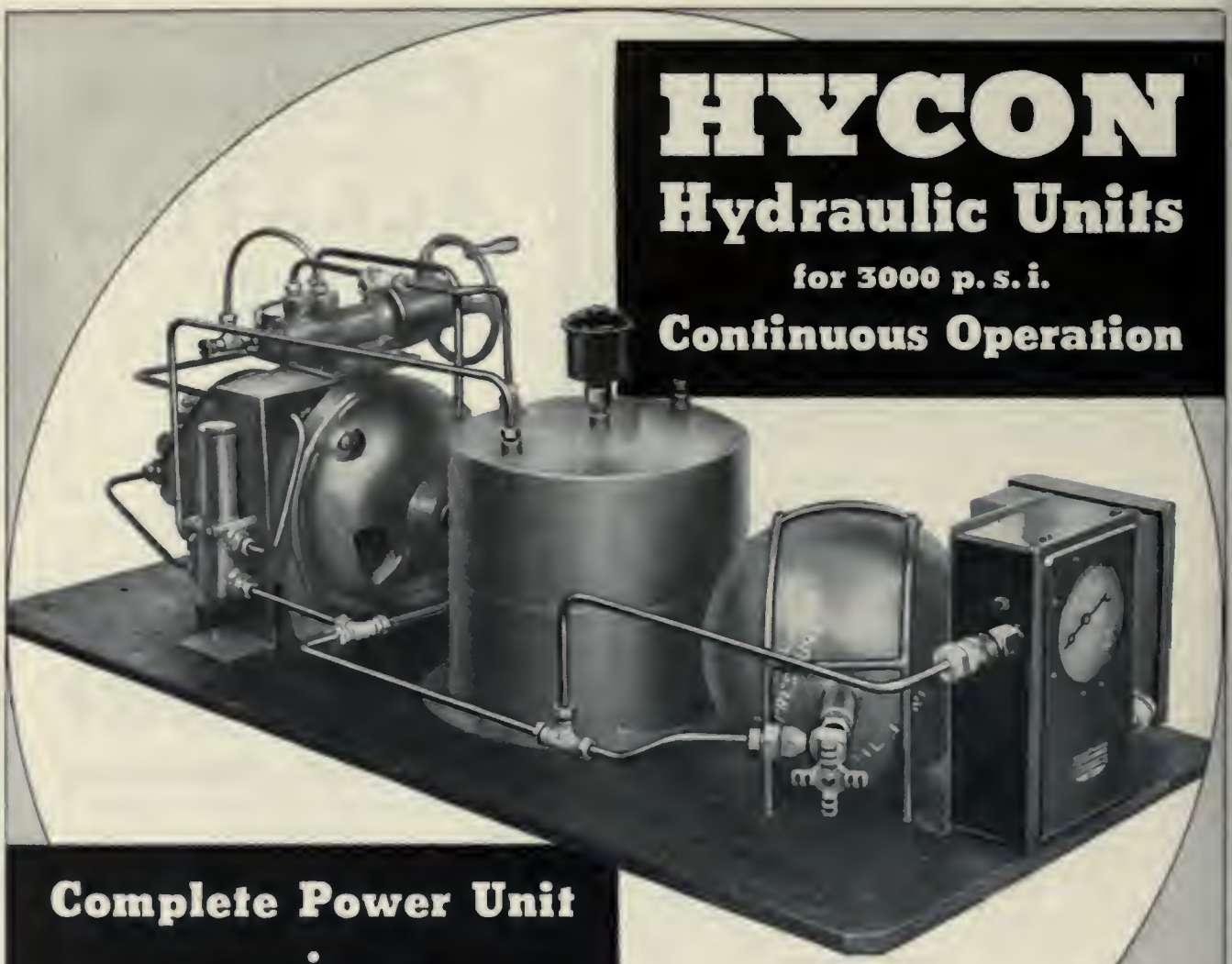

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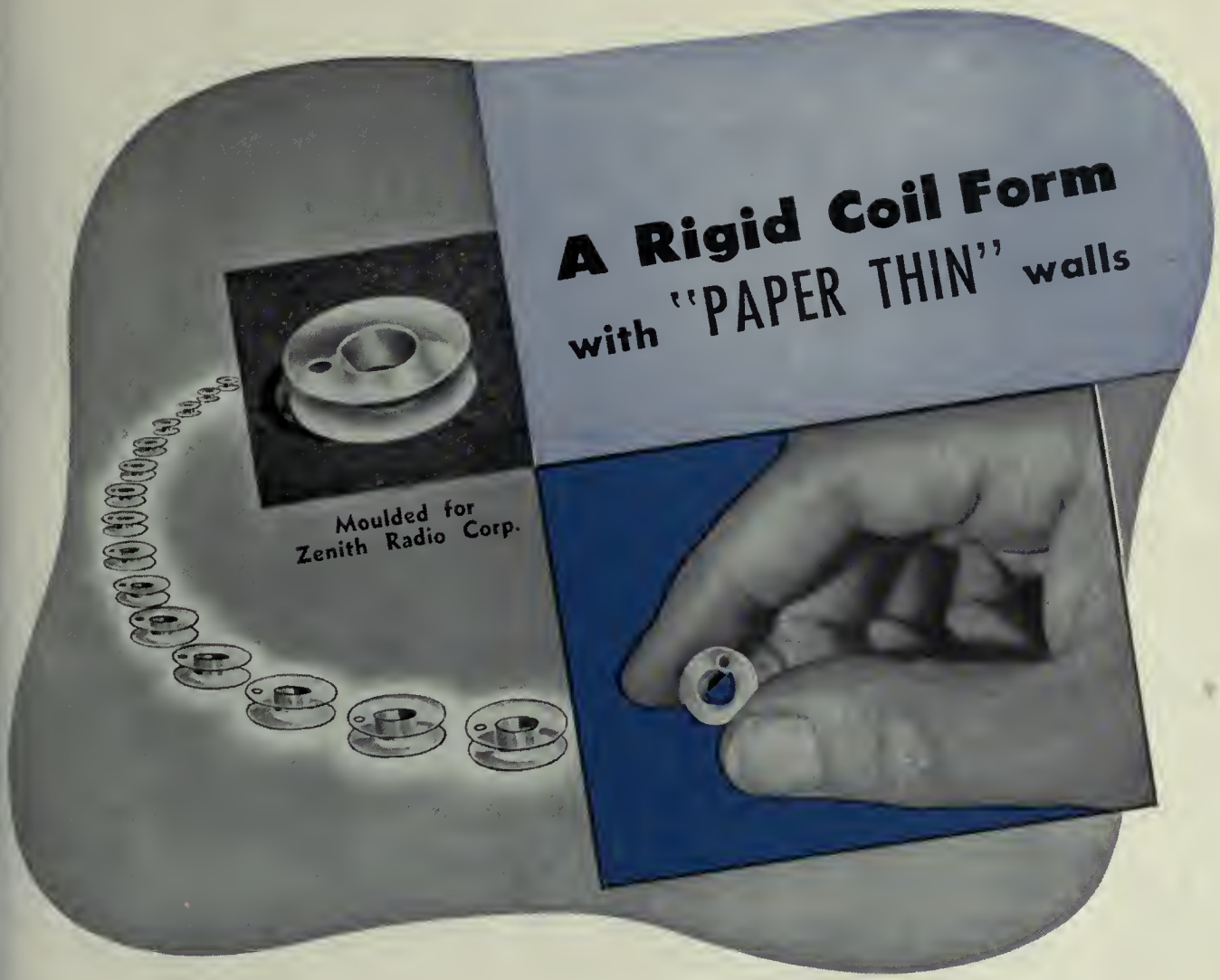

A big job often comes in o small packoge. This tiny coil form, moulded for the Zenith Heoring Aid, confirms the precision of our die moking ond the remorkoble copocity of our own injection moulding mochines. Consider the woll thickness of this form, a scont ten thousandth of on inch thick, yet sufficiently rigid to hold o coil of fine wire occurotely in ploce.

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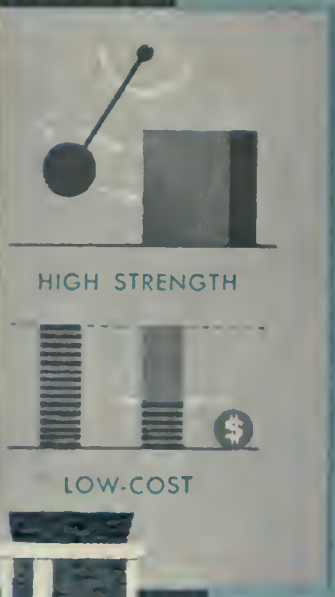

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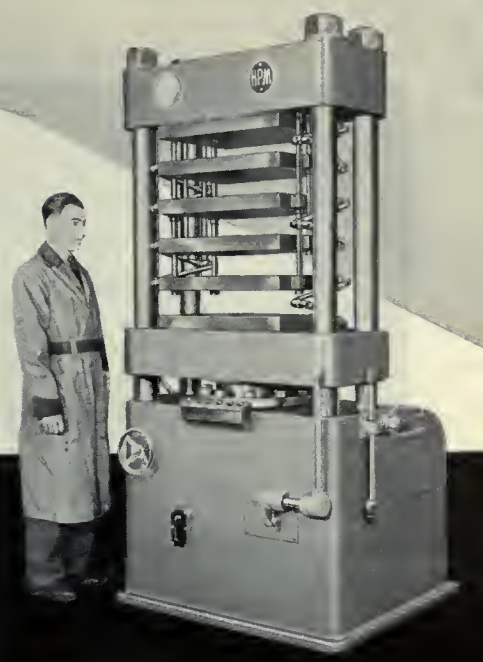
CAST PHENOLIC RESINS LIQUID RESINS • MOLDING COMPOUNDS

HPM UPWARD ACTING TYPE—Self-contained platen presses. Open rod construction, equipped with one or more hot plates, according to requirements. H-P-M HYDRO-POWER radial pump, oil pressure operating system.

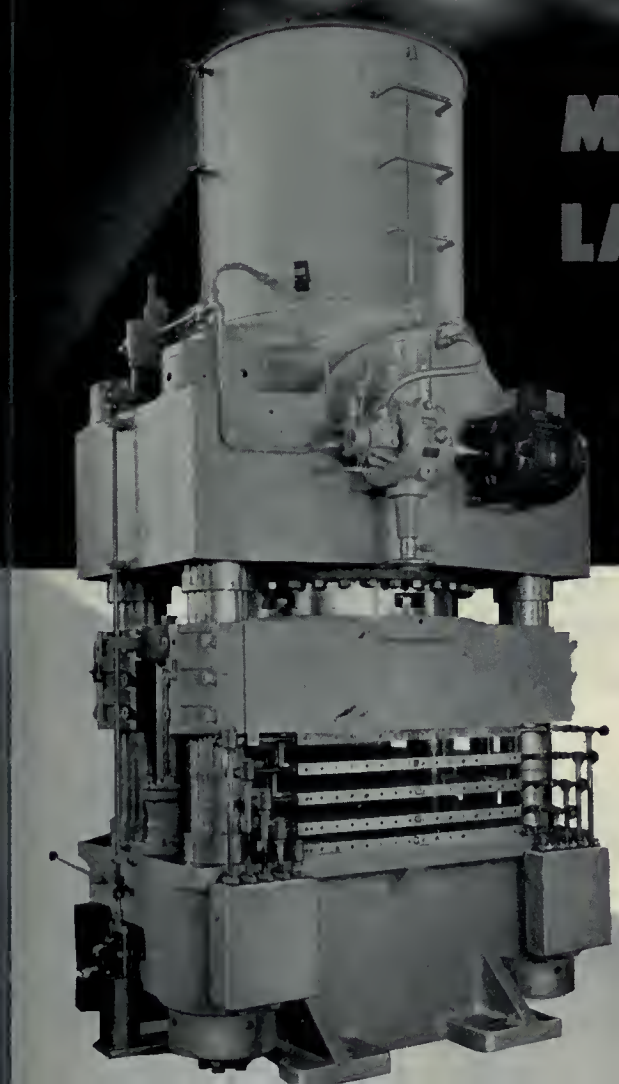
SIZES						
Tons	50	100	150	200	300	500
Hot Plote Size	18"x18"	24"x18"	24"x24"	30"x24"	36"x30"	36"x36"
Rom Travel	12"	12"	12"	12"	18"	18"
Motor (HP)	3	3	3	3	7½	7½

Note: Daylight opening between plotes, ond number of plotes occording to requirements. Longer size presses built on speciol order.



H·P·M Hot Plate Presses

FOR THE MASS PRODUCTION OF LAMINATED PLASTIC MATERIALS



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plastics

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FRONT COVER: Various methacrylate models are used by Socony Vacuum Oil Co., Inc., to clearly demonstrate the lubrication in an engine cylinder.

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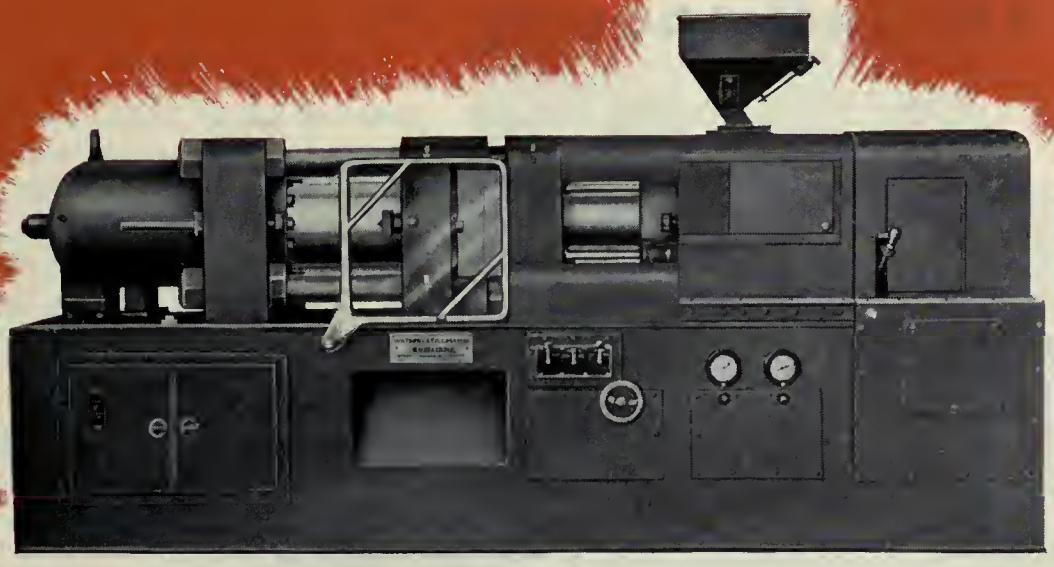
MANY NEW FEATURES...



New W-S Horizontal Injection Molding Machine — capacity range: 8 to 24 oz.

suggested by your fellow molders

We asked molders to suggest improvements to the first models of W-S standard Injection Molding Machines. Now ...here they are...incorporated in the new W-S 6 to 24-ounce Horizontal Injection Machines.

The consensus, based on Molders' experience with W-S machines, was not to change certain W-S features on the injection end, such as:—

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Changes suggested—and followed—are:—

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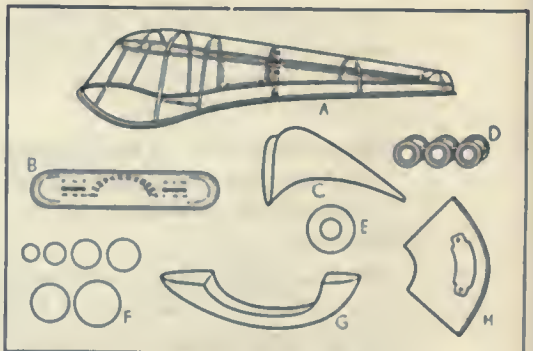

(a) Glider canopy—sheet forming; (b) Dashboard dial—compression; (c) Fairing—lamination; (d) Shell plugs—injection; (e) Gear shift ball—compression; (f) Door knobs—compression; (g) Drawer pull—compression; (h) Refrigerator corners—injection.

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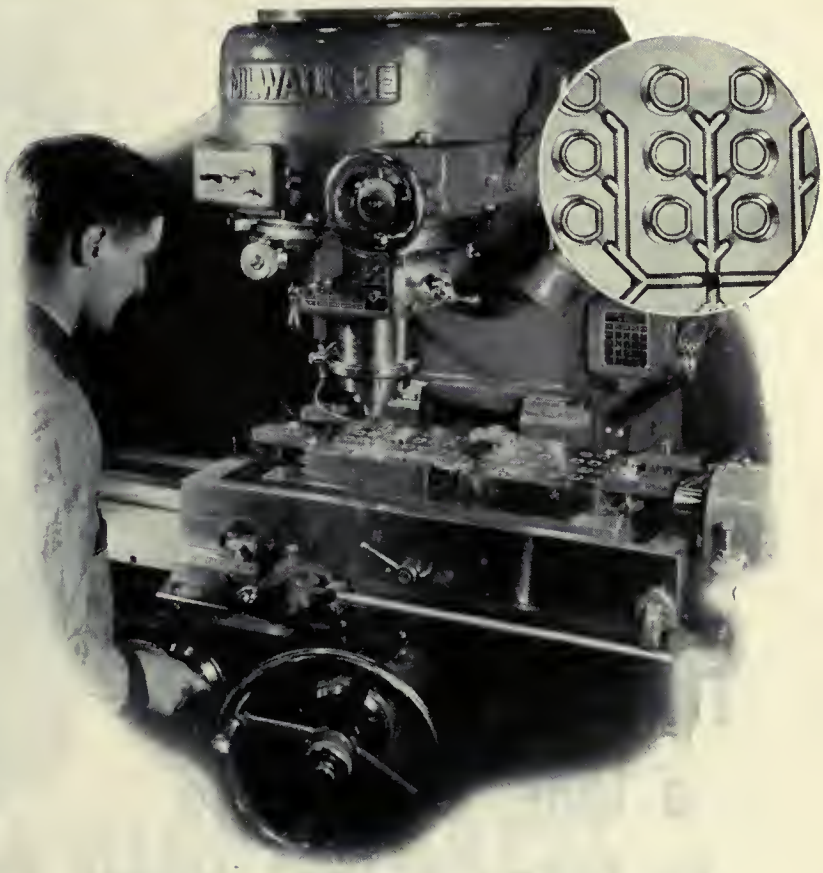

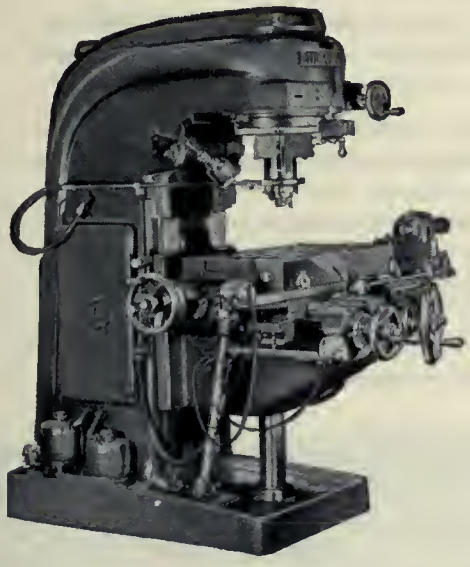

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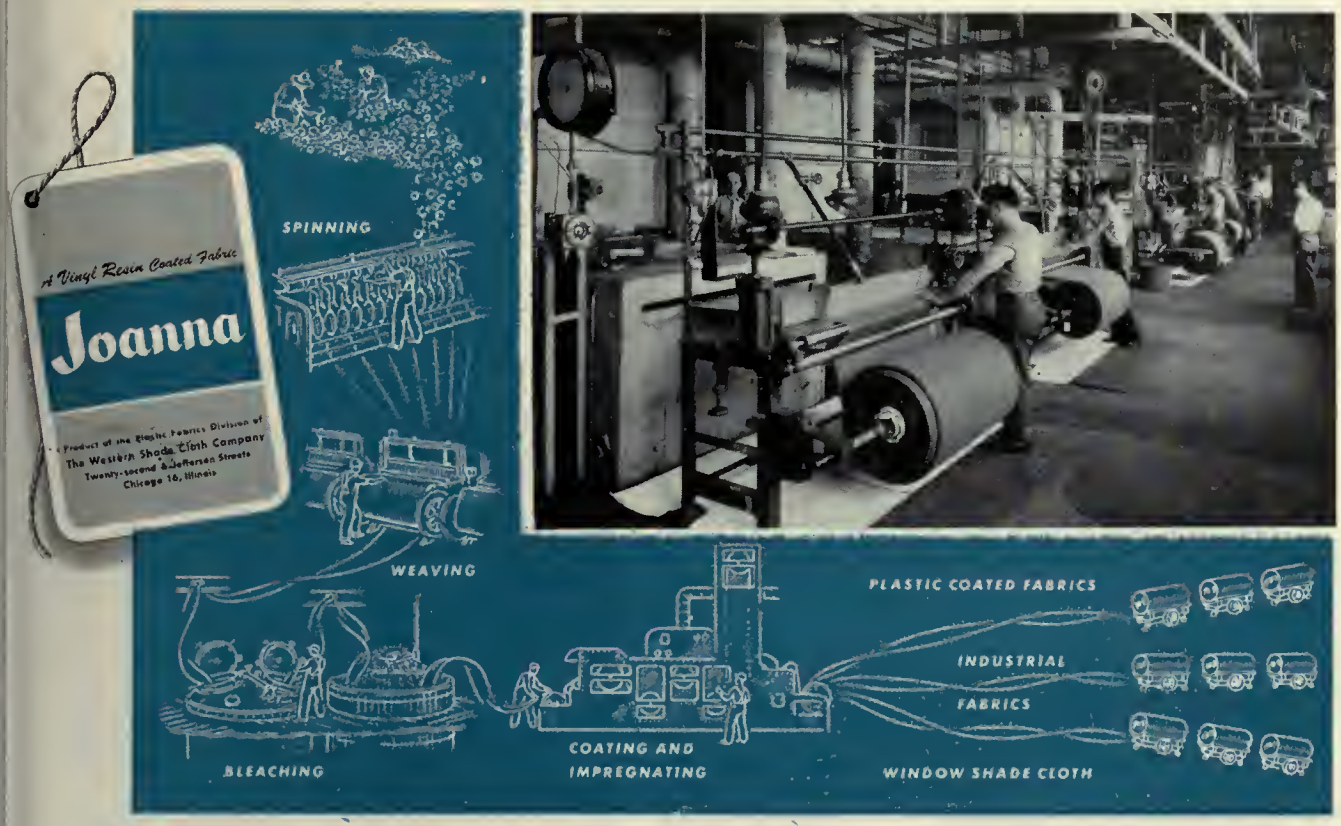

PLASTIC COATED FABRICS may play an important part in your plans for the future

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Vinyl resin coatings are here to stay. Called upon, after Pearl Harbor, to pinch-hit for scarce, conventional fabric proofing materials, they have performed superbly under most difficult conditions. For hundreds of applications they have permanently replaced the protective materials for which they were substituted.

Coating fabrics with plastics is nothing new to our organization. Long before Pearl Harbor, it was an accomplished fact. With a background of nearly half a century of fabric coating experience we were among the first to master the difficult technique of applying plastic coatings to cottons, silks, rayons, nylons, ducks, burlaps and paper.

Chances are that somewhere in your post-war operations you will use to good advantage some type of fabric coated or impregnated with protective plastics.

You, for instance, may be a manufacturer of items for consumer sale such as luggage, furniture, books, rain wear, shoes, shower curtains, garment bags, baby carriages, mattresses — or —you may be a manufacturer of heavy goods such as railway coaches, airplanes, automobiles, trucks, refrigerators, etc. If yours is a fabric problem, we believe we can supply the answer.

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JOANNA TEXTILE MILLS, GOLDVILLE, SOUTH CAROLINA

HOW TO USE COOLANTS WITH PLAX POLYSTYRENE

If the temperature of polystyrene is not raised above 60°C (140°F) during machining operations, no difficulties will be encountered.

Gumming, surface disfigurations, and crazing (surface cracking) occur when heat generated by drilling or cutting exceeds this temperature. Crazing will occur even before gumming, and it may appear immediately, or a week after machining.

It is almost impossible to measure the surface temperature rise of plastics, because heat is generated for a very short time at a usually very small point of cutting. Polystyrene's splendid electrical insulation properties are accompanied by exceptional heat insulation qualities, which prevent this plastic from quickly giving up its heat.

Overheating can be prevented by (1.) elimination of excessive friction and provision of adequate chip clearance, and (2.) use of a proper coolant. Kerosene or other ordinary cutting oils will damage polystyrene.

Laboratory study at Plax has shown that a water soluble coolant that will wet both polystyrene and metal gives the best cooling action. (And, incidentally, eliminates change-overs when the same machine is used for both plastics and metals.)

Most coolants in this category are injurious to polystyrene but several that are completely neutral to the plastic are available at low cost. Two of these are Shell Oil Company's Vergo Oil 38-P and Stanco's Solvac 100-M Special. One of these, or a coolant equal in performance, should always be used in all sawing and drilling and in some turning and milling operations.

When the above-mentioned points about machining polystyrene are recognized and provided for, intricate parts can be produced without trouble due to overheating.

PLAX POLYSTYRENE IS SUPPLIED in sheets, rods and tubes. It is also available in the famous Polyflex* Sheet and Polyflex* Fiber, tough and flexible extruded forms with wide insulation application. Machined parts such as those shown above (in actual sizes) are produced by Plax, to your specifications. Plax also supplies a polystyrene cement.

Other Plax wartime production includes various forms of cellulose acetate, cellulose acetate butyrate, ethyl cellulose, methacrylate, and styramic.

Write for bulletin on "Fabricating Polystyrene," containing full details of polystyrene's properties.

*Trade Mark Reg. U. S. Pat. Off.

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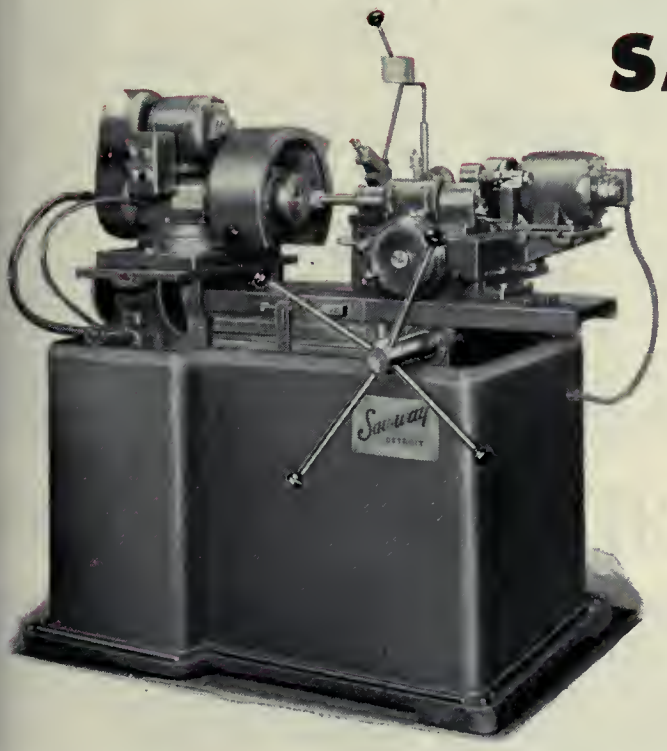

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PLASTICS in PERSPECTIVE.....

AS AN industry postwar plastics faces a rosy future. All signs point that way, and unless every present indication proves to be completely wrong, there is a strong likelihood of an industrial reshuffle that will put plastics at or near the top of the heap. And, there is good reason to believe that its growth will rival that of the meteoric aviation industry which in the short span of 30 years became America's industrial giant.

We can all revel in the prospects for plastics and gird ourselves for the hard work ahead. But, we must never allow the inherent glamor of plastics or its dormant romanticism to get out of hand. Already many of our government officials are concerned lest this happen. And, as our Washington correspondent Arnold Kruckman points out in this issue, they are taking vigorous protective measures against such possibility. Their action sets an excellent example for us.

The tendency to overdramatize and overstress the possibilities of plastics' immediate postwar future is dangerous and fraught with dire consequences should intelligent design progress fail to keep pace with what improvements the public had been led to expect. Herein lies the possibility for the greatest damage which could be done to the orderly growth and development of the industry, both industrially as well as financially.

In this, then, we all have a most important task confronting us right now. We can do our share of perpetuating the industry on a firm, businesslike basis by not overcoloring or overbooming our industry or even our products. These in most instances, are good enough to let their inherent qualities and characteristics do the talking for them. If we permit our products to sell themselves by their excellent performance in service, we have little fear that the public will expect the impossible. After all, even plastics, cannot perform miracles. They have done right well by coming awfully close to performing them.

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TWO articles in this issue which deal with new developments illustrate the dual direction which progress in the industry may take. The article on *Velon* introduces a new material which has potential applications in several fields. This is the more familiar type of development—something you can see and touch, something you can get samples of even before the product is ready for fullest exploitation. We may call this the visible kind of progress.

The other kind is illustrated by the article discussing new methods of treating various textiles developed in the Monsanto laboratories. In this case the synthetic resins are virtually invisible. What you see are the wool, silk, cotton or rayon fabric or products looking just the same as they did before they were treated. And so it is with the resins used for coating fabrics, for adhesives, for giving paints and other finishes better protective properties.

The public has heard a great deal more about the visible than the invisible materials which have incited progress in plastics, because in the first case they play the leading role—are in fact the whole show—while in the second case they are "also in the cast." But generally the also is a big word. A cane isn't very important compared to a man, but without it the maimed can't get very far. In many applications the invisible plastics play the part of the cane. We in the industry must therefore be more alert than the general public to both developments.

•

BECAUSE ours is a young and rapidly changing industry, we tend to think of older industries as static. What fundamental changes can there be, for example, in steel? We may assume we know pretty much the basic facts about alloys. Yet, as International Harvester's Mr. Knowlton told the SAE's National Tractor group in Chicago recently, the wartime use of so-called alternate steels, especially the *national emergency* steels, "once heralded as leading to certain disaster, is enabling the United States to out-produce the world." And these substitute low-alloy steels proved themselves so satisfactory that there is now a trend toward selecting steels by their physical properties—especially hardness—rather than by chemical composition.

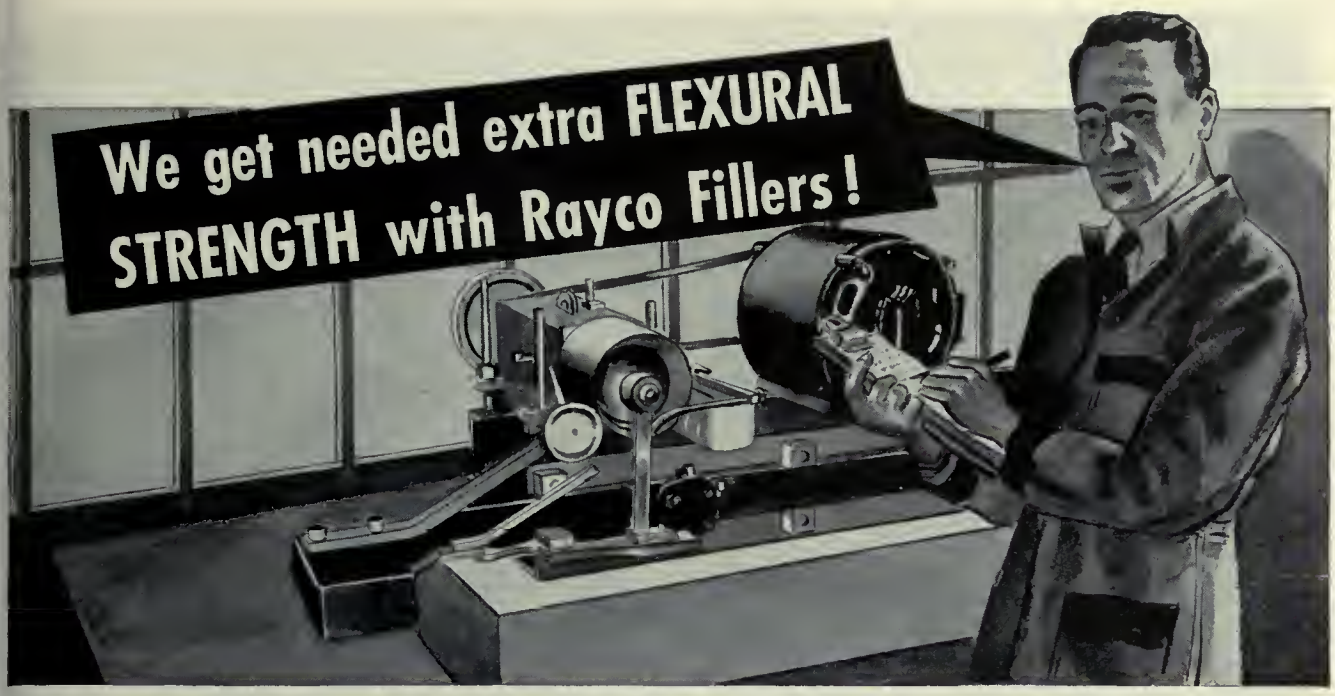
There is a two-fold significance in this for the plastics industry. The first is that an industry, like a man, is no older than its arteries; and Steel's, as the above example indicates, have not become case-hardened; it can still absorb shock rapidly and change readily. Secondly, we must watch developments in that industry which will make it competitive with our own, on our own ground. There is the new pressed steel to be weighed against our laminates and low pressure molding products; there is the powder metallurgy technique, with its potentialities still unmeasured, capable perhaps of joint enterprises with plastics powders. Let's not sell other industries short.

•

A RECENTLY reported development of some interest is Goodyear's production of a synthetic rubber tire which is said to overcome the cracking and overheating to which the larger truck tires have been subject, making their use much less satisfactory than that of the synthetic rubber tires designed for passenger cars. Goodyear has now introduced a new tread to overcome these defects, a tread which the company labels revolutionary because "it was developed especially to meet synthetic rubber's peculiarities rather than a new attempt to adapt methods used in the tread designs of natural rubber tires."

That strikes home! Engineers and designers who have contributed to PLASTICS have all been emphasizing the need of utilizing the specific characteristics of the various synthetic resins in making new products. They have been saying that plastics articles should not be made to look like metal, wood or any of the traditional materials, for therein lies the danger of shaping them into traditional designs which do not take into account the properties of the plastics themselves. Now if the fabricators of synthetic rubber must make revolutionary changes to adapt it to the same uses as natural rubber, how much the more should we in the plastics industry tackle our problems with fresh and unbiased viewpoints

END



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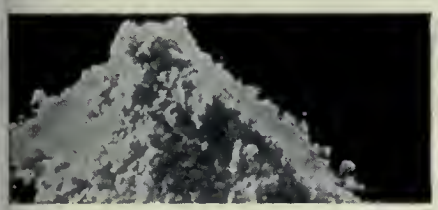

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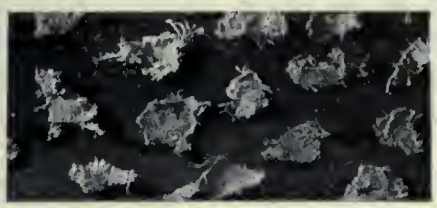

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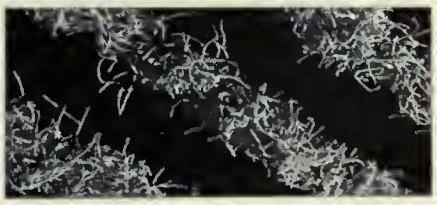

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In planning your post-war production, you should have the benefit of the best available data on cotton Fillers. We make this available to all molders. Primarily, of course, our work is with compound manufacturers, who gladly cooperate in furnishing you with compounds formulated with the desired type and cut of Rayco Filler.

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Major credit must, of course, go to the performance of today's resins, which cure with little, or in some cases, no heat or pressure. Fiberglas Textiles, used as reinforcement in low-pressure laminates, have proved to be good teammates for these resins . . . working well with them, sharing with them certain basic characteristics. For glass possesses inherently some of the properties most sought after in low-pressure laminates.

The ingenuity of the fabricators of low-pressure laminates has kept pace with the remarkable and rapid developments produced by the resin manufacturers. And many fabricators have already found that Fiberglas Textiles, incorporated as reinforcement, contribute to ALL the desirable properties listed above in finished laminates.

Recently, the U. S. Army Air Forces have permitted the publication of some of the results of extensive investigations of Fiberglas-reinforced laminates in aircraft construction. This information will be of great interest to anyone concerned with low-pressure laminates. Reprints of the published data gladly forwarded on request . . . *Owens-Corning Fiberglas Corporation, 1881 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

FIBERGLAS . . . is glass in the form of fine fibers or continuous filaments. Fiberglas is twisted into yarns and woven into a variety of textile materials possessing the many advantageous properties of glass, plus flexibility and high tensile strength—and adaptable to all the requirements of low-pressure laminating. Fiberglas Corporation *does not manufacture either the resins or the finished laminates,* but shall be pleased to direct you to sources of supply.

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*T. M. Reg. U. S. Pat. Off.

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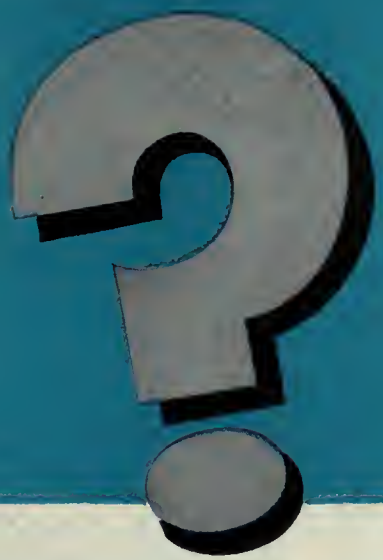

Machinery? Certainly equipment is mighty important, and that's why General Industries Company has one of the finest equipped plants in the country—including presses for every type of molding, from very small to extremely large sizes.

Mold making? You can't expect to get a perfect molded part unless the pattern is perfect. That's why we prefer to make our own molds. In all modesty, we believe the ability of our mold designers and makers can't be excelled by any plant in the nation. The right molds mean accuracy, fine finish with a minimum amount of time and cost for machining or hand work.

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Resourcefulness? Every plastic molding job we undertake is studied carefully by our engineers to see if any way can be found to improve the quality and utility of the part and reduce the cost. Frequently, from our experience we are able to accomplish all three of these objectives.

Reliability? This perhaps is the most important characteristic of all. It means deliveries on time, of the quality specified, at the price quoted, without bickering. Many customers tell us they prefer General Industries because they know we won't let them down in even the smallest particular.

So, if you are planning postwar products which include molded plastics, we suggest you keep in touch with us. Right now, we're so full of Uncle Sam's work that we cannot take on anything additional. But when that job is finished, we'll be glad to work with you.

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● Above you see a part of the Amos engineering department, where men with exceptional ability design the plastic part or product for practical utility—for functional use—for dependable performance—and for fine appearance if desired. In the picture you see J. C. Kazimier, chief engineer, checking a job on one of the boards.

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AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

These two pieces of wool fabric were both originally the same size. The larger, however, was impregnated with "Resloom" M-75 melamine resin before being washed. The smaller was not treated. Below, the author is shown at work in his laboratory

Plastics Give New Characteristics to Textiles . . . .

By Dr. D. H. Powers

Director, Sales Development, Textile Chemicals, Monsanto Chemical Co.

Monsanto Discoveries Eliminate Shrinkage, Shine, Snags and Runs, Also Provide Water-Repellent Finish for Varied Fabrics

RECENT researches conducted in the laboratories of the Monsanto Chemical Co. at Dayton and Boston have opened up three large fields of application of plastics to textiles. First, it has been shown that when woolens are impregnated with low concentrations of melamine formaldehyde polymers, termed *Reslooms,* the woolens can be washed repeatedly without felting or shrinking and these *Reslooms* are particularly valuable for textile application because they are water soluble and can be easily applied with existing mill equipment.

Secondly, a water-repellent finish was developed from melamine formaldehyde polymers which is applicable to cotton, rayon and wool fabrics. This product was the result of years of research at the Dayton laboratories and makes available a new and important market for plastics in the textile industry.

Thirdly, a colloidal solution of silica, known as *Syton,* has been produced which reduces the slippage of rayon and the snagging of sheer hosiery. It also lowers the surface luster of filament yarns so that, to name one example, it can eliminate shiny pants.

While the application of coating resins has long been

These half-wool, half-cotton stockings graphically illustrate the effect of "Reslooming"

known, this new development is concerned with the impregnation of the fiber with resin-forming solutions. While coatings have found wide military application in raincoats, ponchos, etc., they do not alter the physical characteristics of the fibers. They do not change their shrinking properties, their resilience, or their elasticity. However, low concentrations of resin formers, when applied to the heart of the fiber and when polymerized or cured there, radically change its properties, reducing its moisture sensitivity, and shrinkage, changing its tensile strength, and especially its elasticity.

The method of application also has a tremendous effect on the qualities obtained in this fiber impregnation. As little as 2% melamine type resin may well reduce the shrinkage of a fabric as much as 75%. Yet, when the resin is impregnated into the heart of the fiber, the softness and surface appearance of the fabric is unchanged. A woman may purchase a fabric containing as much as 15% of impregnated resin without realizing that the fabric has been treated in any way. It is particularly striking that in some cases as much as 20% impregnated resin does not waterproof the fabric or prevent it from absorbing water, so that it can be dyed and processed in the mill just like an ordinary fabric.

Another reason why the *Resloom* resins, which are used for impregnating fibers, are unsuitable for coating, is that they are extremely hard and tough. Before they could be used for coating resins, they would have to be highly plasticized.

Type of Resin Used

Resloom resins are modified melamine formaldehyde resins. The melamines themselves were first synthesized more than a century ago, but they have only been available on a commercial scale for the last few years. Condensing the melamine with formaldehyde produces methylol melamines which are extremely water soluble when unpolymerized. It has also been shown that the lower alkyl ethers of the methylol melamines have excellent water solubility and stability, while the higher alkyl ethers are solvent soluble but water insoluble. For textile application it has been essential to produce a melamine type resin which is infinitely soluble in water and extremely stable on diluting, and which can be readily applied from a thin, low viscosity, aqueous solution to the heart of the fiber. For this work the methylol melamines and the alkylated resins with lower alkyl groups have shown the most promise. It is important, however, that in all this work unpolymerized or low polymerized resins be used, for when these methylol melamines polymerize, the solutions become viscous, penetration into the fiber is poor and much greater stiffness in the treated fabric results.

The technique for mill-scale "Resloom" operations was developed from laboratory padders such as this

Special advantages of the *Resloom* type resins are their complete absence of color, their extreme light stability, and their freedom from oxidation. It also has been shown that these resins are extremely resistant to acid, alkali and solvens. This solvent resistance is of particular interest on wool, which normally is dry cleaned. The alkali resistance gives to these resins excellent resistance to washing. At the same time their resistance to chemical solvent deterioration makes it extremely difficult to remove them from the fabric when properly cured. At present it is not possible to remove quantitatively the resin from the fabric without destroying the fabric, and removing it from the resin.

Application to Typical Fabrics

A sample of woolen flannel on washing in a rotary washer will shrink about 20%. This washing is for 15 min at 100° F with just sufficient neutral soap to give a heavy suds. The fabric is then rinsed for 15 min at 100° F. This is

After it has been dipped in M-75 melamine resin solution, cloth is then passed between squeeze rollers in order to remove excess and achieve the desired penetration of "Resloom" into the fabric

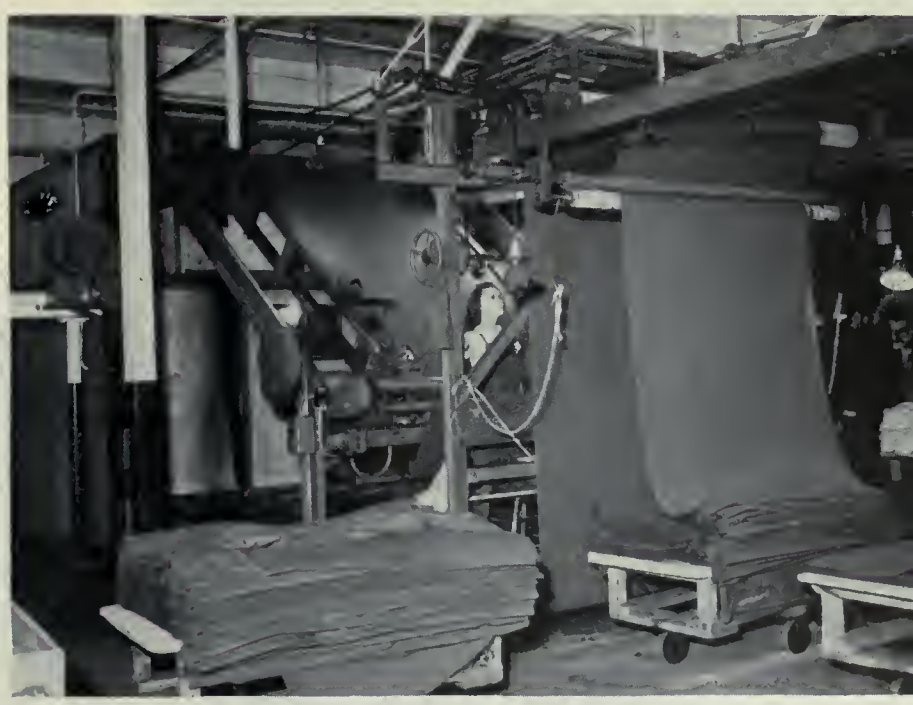
the standard procedure which has been developed for determining the shrinkage of fabrics other than cotton and is designed to avoid any damage of the fiber itself. This fabric when treated with an aqueous solution of *Resloom* M-75, a water soluble methylol melamine, so that it picks up 12% of the resin, will produce a plastic modified flannel which when washed in exactly the same way shrinks only 4%. This is just one case where the shrinkage may be reduced more than 75% by treating with *Resloom* type resin. It is also true that this fabric has an appreciable increase in resistance to repeated abrasions as determined by the Taber abrader, and the fabric has a reduced water sensitivity or water pickup. This does not mean that the fabric is waterproof, but that swelling and pickup are half normal.

When a soft all-wool shirting, of a particularly light weave, is washed according to the procedure outlined above, it may well shrink as much as 30% on a single washing. But, when treated with a 15% solution of *Resloom* M-75, this fabric will show a shrinkage of under 7%, again a reduction of over 75% in the shrinkage. A shirting fabric which is composed of 45% and 55% rayon, when treated with a 10% solution of the methylol melamine resin shrank 5%; before treatment it shrank 26%. If this fabric were given a mild careful wash it would shrink about 8-10% before treatment and under 2% after treatment.

All-wool socks when treated with 10% to 15% solutions of *Resloom* M-75 show a reduction in shrinkage of 70% to 80%. All-wool socks are treated after dyeing in a dye kettle containing the *Resloom* solution and allowed 10 to 20 min for thorough resin penetration. The fabric is "whizzed" or hydro-extracted to remove surface resin and excess resin, is dried in a hurricane or continuous drier, and boarded on metal boards running through a steam-heated drier for 3 to 6 min. The socks are then rinsed to give a soft resilient sock which will shrink very little on repeaed hand washings, in contrast with the untreated sock, which may drop from size 11 to size 8 in a single hand wash.

While examples are cited of shirting, dress goods and socks, it is evident that the use of *Resloom* is also of great value in blankets, underwear and suitings. It is indicated that they may open up new markets which have not been available to the woolen trade, particularly in the field of wash goods.

(*Continued on page* 102)



Pin-frame dryer used to dry and cure "Resloomed" woolens

Grinding Metals with Resinoid-Bonded Abrasives

By E. T. Larson

Norton Co., Abrasives Division

ONE of the less publicized but extremely important applications of synthetic resins is to be found in the grinding wheel. The resinoid-bonded grinding wheel is no "war baby" but was first made available to industry about 20 years ago as a high-speed snagging wheel with an open structure. Since then its use has been extended to almost every kind of grinding. It has proven so valuable in expediting war production, that as a result its use will undoubtedly continue to spread to new fields after the war.

As an indication of the impact that this type of wheel has made upon industry, grinding machines of numerous types have been developed for the express purpose of operating wheels at the high speeds made possible through the use of the synthetic resin bond. For example, in the foundry cleaning rooms, high-speed grinders of the swing-frame, floor stand and portable types, equipped with fast-cutting resinoid-bonded wheels, are smoothing the alloy steel castings and forgings that now enter into the construction of tanks, trucks, locomotives, gun mounts and ships.

In the nation's vast shipyards, batteries of high-speed swing-frame grinders mounting 24" diameter resinoid-bonded wheels are shaping the contours of massive propeller castings, gun turrets and large deck fittings.

As a result of the tremendous expansion in the use of fabricated steel structures of all kinds—even to ships' hulls—the long familiar staccato of riveting hammers has largely given way to welding torches and high-speed portable grinders spurting streams of sparks, which are actually chips of red hot metal.

To insure a sound weld, the butting edges of two plates to be welded together must be clean and smooth, and after welding, the rough head that is left must be ground off, provided the specifications call for a smooth, contin-

Smoothing welds on Navy anchor chain with resinoid-bonded grinding wheels driven by a high-speed portable grinder

Bronze propeller casting is smoothed by wheel bonded with synthetic resins, driven by high-speed swing-frame grinder

Special machine designed for automatic thread grinding utilizes a resinoid-bonded abrasive wheel for its work

Able to Operate at Rate of Two Miles per Minute, These Tough Tools Have Expedited War Work, Offer Industry Permanent Gains

uous surface. For both of these grinding jobs, fast-cutting resinoid-bonded abrasive wheels 6 and 8″ in diameter have proved unusually effective. Another impressive sight in shipyards today is grinding the links of huge assembled anchor chains to remove the surplus welding material, using high-speed portable grinders equipped with resinoid-bonded wheels.

There are hundreds of other grinding operations connected with the production of vital war materiel where fast-cutting resinoid grinding wheels, in one size or another, are contributing in perhaps a less spectacular but nevertheless most effective way. To cite just a few more examples, the huge chilled iron rolls which stack up several stories high for rolling out steel armor plate, rails, girders, etc., from red hot billets, are reconditioned by grinding with 30″ diameter resinoid-bonded wheels.

Piston rings, aluminum and magnesium castings for aircraft motors, permanent magnets and springs of every description are today being surface ground on so-called disc grinders that are usually equipped with resinoid-bonded wheels because of their unusual resistance to grinding heat as well as their smooth-finishing qualities.

One of the first types of resinoid-bonded wheels developed was a thin, self-sharpening, abrasive "saw" or cut-off wheel for cutting all kinds of materials of construction, including hardened steels and ceramics. Available in solid form up to 16″ in diameter, resinoid-bonded abrasive cut-off wheels, ⅛″ thick and even thinner in the smaller diameters, can be safely operated at speeds up to 16,000 surface fpm with amazingly rapid rate of cut.

The astounding production records being set by our war plants today have been achieved in no small measure by the widespread use of high-speed tungsten carbide tipped cutting tools in various machining set-ups. Like any cutting tools, these carbide tools depend upon keen cutting edges and accurately ground tool angles and chip breakers for their efficient performance. While it is common practice to rough-grind carbide single-point tools on silicon carbide abrasive vitrified bonded wheels, diamond abrasive wheels are generally used for the final sharpening and chip breaker grinding operations.

In one of the three standard types of diamond wheels being produced today, the abrasive section consists of minute, carefully-sized diamond particles uniformly bonded with a synthetic resin and molded to a depth of usually $\frac{1}{16}$ or ⅛″. The resinoid-bonded diamond wheel is exceptionally fast and cool-cutting as well as wear-resistant—properties which also make it ideally suited to precision grinding of carbide tipped face mills and other multi-point tools.

Not so long ago the grinding of threads was limited to an occasional tool room job. Today, automatic precision thread grinders are grinding screws, taps and gages "from the solid" on a high production basis and with almost unbelievable accuracy. As might be expected, special grinding wheels had to be developed for use on these thread grinders and in this development very hard and wear-resistant resinoid-bonded wheels shared the honors with vitrified wheels. Each has its merits. Resinoid-bonded wheels seem to hold their edge better and to produce a brighter finish. The very latest development in thread grinding wheels is a diamond abrasive resinoid-bonded wheel for grinding special large aircraft taps with durable tungsten carbide inserts.

Basically, a grinding wheel is simply a form of cutting tool. It may be likened to a milling cutter with thousands of tiny individual teeth in the form of hard and sharp abrasive particles on its cutting surface. Consider, for example, a medium grit wheel, 24″ in diameter and 3″ in

(*Continued on page* 93)

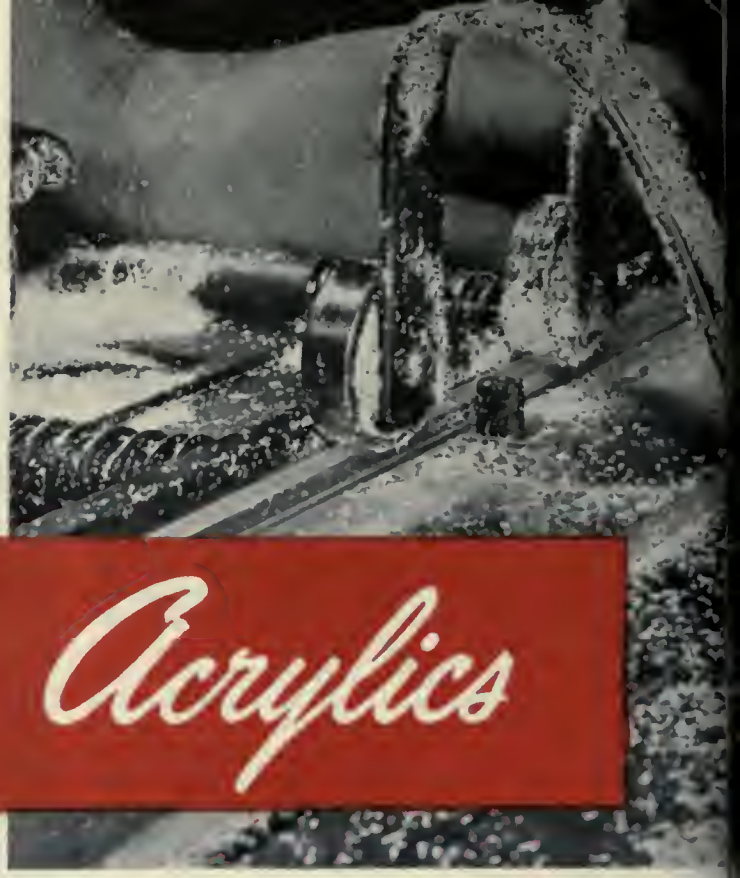
Resinoid-bonded cut-off wheels 16″ in diameter and ⅛″ thick cut tubular metal stock to be used in furniture

Sharpening a carbide-tipped lathe tool on an abrasive resin-bonded wheel containing minute diamond particles

How to Adapt Metal-Working Tools to Wood-Working Machines in the Absence of Equipment Specifically Designed for the Shaping of Acrylic Materials

By Malcolm Steiner

Steiner Manufacturing Co.



MACHINING *Acrylics*

A narrow grooving operation on the router, with the cutter revolving at high s

IT seems strange that in such a rapidly-expanding field as plastics fabrication the development of new machinery specifically designed for this work has been lagging. The fabricator in plastics today has to make his own adaptations of existing machines. In general, he must adapt metal-working tools to wood-working machines in a number of fabricating operations. No great difficulty is encountered in making these modifications, and that may be the very reason why the demand for special machinery has not become more insistent and why machine designers and manufacturers have spent so little time and effort in this direction. The fact remains, however, that special machines designed specifically for plastics fabrication are a need and present a wide-open field for development.

While fabrication of cast acrylics has its similarities to that of other thermoplastic and even thermosetting materials, there are a considerable number of differences in specific operations. These are due to differences not only in the characteristics of the material itself, but also in the function of the finished article and even in finished appearance. To mention only one example, there is the fact that acrylics generally have finer optical qualities than any other plastics material. *Where optical quality is one of the chief requirements in the completed piece, precautions against surface abrasions must be taken right through every fabricating operation to an extent that is far beyond that needed for any other plastics.* Other differences between the fabrication of acrylics and that of other plastics materials will become apparent from several of the operations described here.

An acrylic sheet as thick as the one shown above (2") necessarily requires a slow feed on the circular saw

Machine operations on acrylics—sawing, drilling, routing, turning, etc.—are, in principle, similar to corresponding operations on other plastics and even on metals. The differences—of allowable tolerances, tool construction, operational speeds—are those deriving from the characteristics of the acrylic itself. An acrylic, far from being primarily a substitute material, is a material in its own right, and that, not only because of what it does, but because of what it is. What it is determines the machine requirements for acrylics. What it does makes possible accomplishments not attainable with any other materials.

Circular Sawing

A circular-saw operation on acrylic plastics is ostensibly the same as the circular-sawing of wood. In fact, with no saw available that is specifically designed for plastics, a wood-cutting saw is regularly used on acrylics. The similarity stops, however, at appearances. For one thing, the linear tolerances for acrylics in this operation are closer than for most woods. Up to about 1 ft in sawed length, linear tolerance on a material such as *Plexiglas* can be maintained to ± .030". On sections of 1 ft and over, tolerance can be held to ± .060".

Tenite scales molded by American Molding Co. for A. Lietz Co.

Dimensionally Stable

● Architects' and engineers' scales are now injection-molded of Tenite plastic to accurate measurements. Tenite has excellent dimensional stability, and there is less warpage of these scales than of those traditionally made of boxwood.

Tenite provides improved legibility. The scales are white, rubbed to a dull finish which affords a strong contrast for figures and lines heat-branded into the plastic and painted black. On triangular scales, different colored stripes lacquered in the grooves on the sides aid in finding the desired scale.

Tenite is an exceptionally tough material, chipproof and not easily marred. It has proved satisfactory for many formerly breakable or easily damaged precision instruments – such as manometers, rain gages. TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

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TENITE

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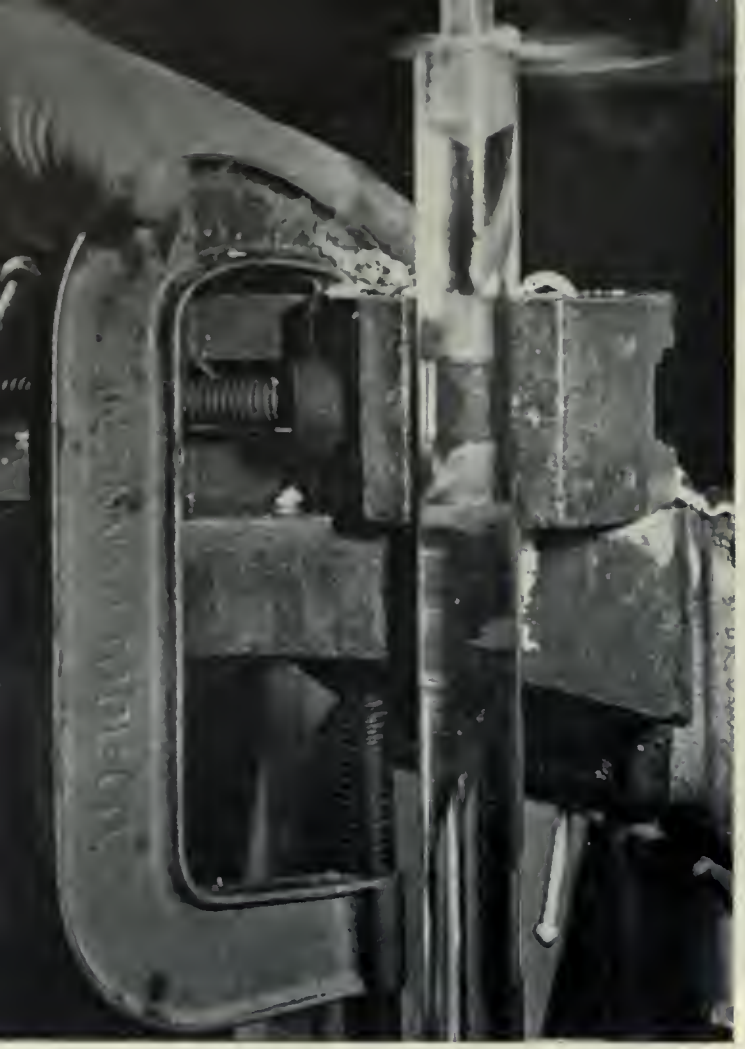

With low operating speed, lubrication in the operating region must be ample for drill as wide as this. Note whirling waste from drill

The choice of a saw blade for a given operation hangs on the thickness of the material and the relative smoothness or roughness of cut desired. A hollow-ground, comparatively fine-toothed blade with little or no set is the one most commonly seen in operation on acrylics. This is particularly true in the case of thinner sections, smoother cuts and closer tolerances. Blade teeth may be anywhere from 5 to 20 to the inch. On thick material, a combination saw is often used, with tooth distribution arranged at four cutting teeth to one cleaning tooth. Operating speeds range around 10,000 surface fpm, with about 20% deviation up or down from this mean, depending upon the thickness of the material.

A word might be said at this point on rates of feed, *not only in sawing, but in all machine operations on acrylics where the feed of the material to the tool or of the tool to the material is a hand-controlled and therefore non-automatic operation,* which is usually the case. There are no standardized rates of feed in these operations. Most feeding is by "feel"; and back of "feel" is long experience and a trained sensitiveness to what is happening to a material that is undergoing an operation.

In sawing acrylics, the expert operator will unconsciously regulate his rate of speed by the way his hand perceives the opposition presented by the material to the blade or by the way his eye perceives the character of the waste or by the way his ear perceives the pitch of the sound of tool on material, but usually by all three. His physical response to all this is automatic.

Acrylics must be fed to the saw slowly in order to avoid binding of the blade or "burning" of the material. Coolants or lubricants for dissipation of frictional heat generated at the point or area of operation *are not necessary if the feed is at the proper rate.* This is especially true of thin sections. Even in thick ones, lubrication can be avoided by slowing up the feeding speed. The optimum feed rate is the one that is just below the point where the

Shown just issuing from the acrylic sheet at the end of a curved cut is a band-saw blade that was designed for the cutting of metal

In this type of operation, the fabricator machines a series of receding steps on a methacrylate disc

saw will bind or the material burn. How closely the operator can come to this rate is a measure of his expertness.

Band Sawing

Band saws, as far as tooth character is concerned, follow the same requirements as for circular saws, with some deviations. The greater the thickness of the material, the coarser the tooth size. The range will run from 8 to 22 teeth per inch. Coarser teeth with a slight set will provide a more rapid but a rougher cut. For a smooth cut, the teeth are fine and there is no set. As is to be expected, the finer the teeth and the smoother the cut, the slower the feed rate.

All of this applies to straight cuts. In cutting curves, however, even though narrower blades are used than for straight cuts, set is necessary in the blade teeth. Usually, a 22 or 23 gauge blade is used for thick sections and a 26 or 28 gauge blade for thin ones. Operating speeds on the band saw range from 1000 to 1500 fpm. Metal-cutting blades are used for band-saw operations on acrylics. This is true also of the jig saw, for which the same requirements apply.

There is one difference: Since jig-saw cuts are often finer than those made by band saw, the plastics material tends to reknit and seal the cut behind the blade. This is prevented by cooling the material in the immediate operating area by a jet of air.

Drilling

A typical example of the adaptation of non-specialized tools to special requirements of acrylics is found in drilling operations. The drills commonly used are of the metal-working type. But the standard drills of this kind tend to grab into the plastic. Therefore, the tool needs modification. *In making this modification, we have to compromise between a web thin enough to facilitate the removal of chips and a web so thin that there is wobbling of the drill.* A good basis for modification of the standard drill for work on acrylics has been recommended by DuPont for *Lucite,* as follows:

Flute angle	17°
Lip angle	70°
Lip clearance angle	4° to 8°
Polished lands	¼ of width of heel

It might be added that polished flutes and heels, as well as wide polished lands, help in removing chips and in keeping the hole cool. Flat-faced drills of the type that have been used on cellulose acetate plastics also are of value in many drilling operations on acrylics, especially for thin stock. On holes of comparatively large diameter, vertically-mounted hollow end mills can be used and, on still larger holes, fly cutters may take care of the job. Of course, regardless of the tool, the larger the hole, the slower the operating speed.

Average operating speeds as a function of drill diameter have been worked out for *Lucite* by DuPont and these may be varied, within limits, for other acrylics. This table of operating speeds shows the relationship:

Drill Diameter (in)	Speed (rpm)	Drill Diameter (in)	Speed (rpm)
1/16	7330	3/8	1220
1/8	2670	7/16	1050
3/16	2440	1/2	920
1/4	1830	5/8	730
5/16	1470	3/4	600

If the holes drilled are shallow and if the operating speed is low, coolants can often be dispensed with. Generally for acrylics, and specifically for deep-holed, high-speed drilling of this material, lubrication is a need for both cooling and chip removal, the hole being kept filled with lubricant at all times. An additional advantage is the improved surface finish of the hole. The simplest lubricant for drilling acrylics is a thin solution of mild soap and water. A better one, and one that avoids the rust problem, is a water-soluble oil.

Frequent withdrawal of the drill from the hole during operation, a "must" in order to avoid chipping, gripping and overheating, should be considered as part of the feeding operation and, therefore, is an integral portion of the feed rate. The difficulty of standardizing feed rate in drilling is even more marked than in other machine operations, not only because of the withdrawal factor, but also because the deeper the drill goes, the slower the rate of feed must be. This much can be said: When an expert operator is at work, the feeding and the withdrawal of the drill are unconsciously so well timed that the whole drilling process becomes almost a rhythmic operation.

A completed piece is belt-sanded prior to finishing

Routing and Shaping

The routing or shaping operation on acrylics has a special problem of its own. Sheets of acrylic plastics are at present manufactured only with caliper-tolerance thicknesses. This means that it is impossible to maintain close tolerances, for example, in both the depth and the

Final buff-polishing is a meticulous job on acrylics, which are often used particularly for their clear optical characteristics

toe of a step rout. *Either one* will be accurately dimensioned, but the other will keep the variations existing in the thickness of the material. If the cutter blades work at the upper surface of the sheet, the toe of the rout will be at required tolerance, but the vertical depth of the rout will vary in accordance with the original thickness tolerance of the material. If, on the other hand, the step is routed at the lower surface as an undercut, the depth of the rout will be precise enough, but the toe will retain the original thickness variations of the sheet. This might be remembered by those customers of acrylic fabricators who require close tolerances. Close tolerances in routings can at present be attained only by either additional routings or other additional compensating machine processes, all of which add to the fabricating cost.

High operating speeds are used in routing, varying between about 7000 and 22,000 rpm, depending upon the diameter of the cutter and the number of cutting edges on the tool. The smaller the number of blades, the higher the speed required. An operation at 7000 rpm would involve a ten-bladed cutter, while a two-bladed cutter would run at about 20,000 rpm. Compromises between the number of blades and the cutting speed are regularly made to provide for a particular operational requirement, with the number of blades increased and the speed decreased for a shaping-to-template operation, or vice versa for smooth-cut high-speed work, although in the latter case, both the number of blades and the speed may be increased together if the diameter of the cutter is small. In high-speed routing, each cutting edge takes a small bite per revolution, thus reducing chipping and toe-cracking tendencies. Standard routing cutter blades need only slight modifications for operation on acrylics, the chief requirements, aside from very sharp cutting edges, being a 10° back clearance and a 20 to 30° rake. Lubricants are not generally used in routing operations. The development of excessive heat at the point of operation is partly avoided by adopting a slow feed of material to cutter (and, in step routing, by also greasing the collar against which the acrylic sheet rides). What is left of overheat on cutter or work is dissipated by the air-suction device used with all routers to remove the chip waste characteristic of operation on this machine.

Most cross-sectional shapes seen in wood routings can be duplicated in acrylics. But it should be repeated that an acrylic is a material in its own right and that it is purposeless to use a routed acrylic strip as a mere substitute for a wood molding. The difference in cost between a molding strip of wood and one of acrylic should be justified by a difference in either proposed function or esthetic requirement.

Turning, threading, facing and other normal lathe operations on acrylics are carried out with modifications of tools used in working on softer metals, like copper and brass. With care, tolerances as close as ± .001" can be maintained in turning and milling operations on acrylates. But, involved in whether such tolerances are justified in the finished product, is the fact that, under use conditions, those tolerances may be vitiated. Under conditions of widely varying temperatures, the comparatively high coefficient of expansion of acrylics may cause sufficient variation in the material of the finished piece to destroy the function of the close tolerance. The expense of machining to extremely close tolerances is justified only when these tolerances are an actual requirement of the function of the part and when conditions of use will not defeat the purposes of such precision.

Rate of feed in most lathe operations, and especially in threading and tapping, can often become quite critical. Yet, critical as it may be, the feed has to be by "feel". And it must be constant. If the revolution, whether of work or tool, stops while the operation is still in progress, the material will "burn".

Lathe operating speeds on acrylics vary not only with the type of operation, but even within any one operation itself. In tapping, for instance, the operating speed will be governed by the style, pitch and dimension of the thread. However, some average speeds, indicative only, for a number of lathe operations can be approximated as follows:

Operation		Speed (rpm)
Turning		2000
Facing		2500
Cut-off		1500
Threading	U. S. Standard Coarse and Acme	100
Tapping	U. S. Standard Coarse and Acme	50

In an operation like turning, a coolant may or may not be used, depending largely on the operating speed. On the other hand, in tapping, a coolant is practically a necessity. A mild soap-and-water solution is used for the purpose or, where there is excessive danger of corrosion of machine parts, a water-soluble oil.

While, in principle, most lathe operations on acrylics follow soft-metal machining practice fairly closely, threading and tapping of acrylics have a number of additional requirements. For one thing, the sharp "V" thread is not advisable for an acrylic part because the material presents no assurance against fracture of the thread apex. Therefore threads of relatively coarse pitch are called for. Then again, since, in use, there is the mating function between thread and tap, extremely close tolerances are inadvisable because variations of use temperature may jam thread against tap to the point where attempt at retraction may damage the part. That holds true not only for temperature variations, but also for use stresses and shocks.

There are many acrylics designs that require a cementing process for their completion. This is true of highly complex structures, but it can also obtain in simple designs. One of the simplest structures that can be fabricated only by cementing is that of flat sheets of acrylic engaging each other in planes at right angles. The only machine operation here is the sawing of the slit in one of the sheets; the rest is a cementing job. Cementing

(*Continued on page* 98)

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▲ *The molded handset ready for ejection from the mold after the 30 second perfect cure.*

◀ *Megatherm heated preforms in press transfer chamber just before closing.*

Photos: Courtesy Shaw Insulator Co.

Federal Industrial Power Tubes, give power and performance to Megatherm and other industrial heating equipment.

Molding time on these telephone handsets was reduced from five minutes to 30 seconds with Megatherm.

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Seeing Through Contact Lenses

By Philip Pollock

Acrylics Prove Their Value In Optical Specialty Due to Light Weight, Durability, Near-Perfect Transparency

Shaped by highly-skilled artisans, the all-plastics contact lens is designed to fit perfectly over the eyeball

OF all the applications of plastics developed in recent years, one of the most interesting is the fabrication of contact lenses from methyl methacrylate resin. Contact lenses are the new vogue in eye-wear. They are inserted under the lids; are practically invisible; give a more precise correction of eye defects than spectacle glasses, and move with the eyeball.

Until recently, they were made of both glass and plastics. The scleral or peripheral portion, which holds the tiny lens, was made of plastic, the lens itself being of glass. This was an improvement over the all-glass shell originally devised but sometimes the plastics and glass separated at the dividing line due to differences in thermal coefficient of expansion.

In 1938 Theodore E. Obrig, authority on spectacle glass, conceived the idea of overcoming this difficulty with an all-plastic contact lens. This idea became a reality when, in 1940, he rented a small loft in New York City, with one technician to fabricate the product.

In a short time, demand for the contact lens soared. Larger quarters were acquired, more assistants trained in the complicated process. By October, 1943, the Obrig Laboratories were located in a six-story building and employed over 40 trained workers. From one machine, equipment had grown to factory-like proportions in 3 years.

To the chemist, the material from which the contact lens is made is a polymer of the acrylic acid derivatives; to the optometrist or oculist, it is beautifully transparent, water-white and optically perfect—in short, almost ideal as a corrective lens. At the same time, the material does not discolor as other resins do in time. It is more transparent than glass and transmits more ultraviolet and infrared rays, the former down to 300 millimicrons with 90% efficiency.

What other qualities are needed by plastics used for this purpose? They must be hard, otherwise they would scratch and warp easily. This was illustrated by the sad experience of an optometrist who drove across a desert with a case of contact lenses made from a softer acrylic in his car. When he arrived at his destination, the lenses had started to flatten out like pancakes due to the terrific heat!

At the same time, if the resin is too hard, it cannot be molded and cracks easily. A compromise between hardness and moldability must be effected. Another point: The plastic used in the lens is not affected by body chemicals. This is not true of the glass shell which becomes rough and discolored in time as in the case of glass artificial eyes that have been worn for years. At the same time, certain chemicals such as acetic anhydride, aniline, amyl acetate and benzene have a damaging effect on the plastics lenses, and also scratch more easily than glass. They are however, more durable, being practically unbreakable, although 60% lighter than glass.

The first step in the making of the contact lens is the taking of an impression of the front of the eyeball. After the eye is rendered anaesthetic with a drug, Negocoll, a soft, sponge-like material heated to about 105° F and held in an acrylic casting shell, is placed against the eye surface. The shell is inserted, first under the upper, then under the lower lid. After the impression is taken, the

Negocoll is removed, registering every variation in the contour. This constitutes the negative mold.

The next step, making a positive mold, is done by placing dental stone, a plaster-like material, against the Negocoll impression for about 20 min, while it hardens. The casting, as received from the optometrist, is never used in the actual production of a lens. An exact duplicate is made by precision methods, and the surface of the duplicate is treated by a special method to prepare it for molding. The cast and a die, with a piece of plastic inserted between them, are placed in an electric oven with a thermostatic control. Careful annealing prevents internal strain as the casting cools. The casting is then removed from the plastic, which is now a perfect replica of the eye surface. One of the principal problems in shaping the lens to fit the eyeball is to duplicate the curvature and size of the corneal portion, which covers the iris and pupil of the eye. The first procedure is selecting a radius of curvature to be formed on the concave surface, which must be predetermined mathematically to give adequate clearance to a point somewhat beyond the sulcus. A novel method has been developed to generate this curve to produce the correct radius, proper depth clearance and an exact predetermined diameter, all in one operation. This is followed by grinding and polishing.

When the concave surface is finished, the radius of curve on the convex surface of the corneal portion must be computed with the aid of a special device, similar in operation to a slide rule, thus reducing the possibility for human error in calculation.

Individual tools must be cut for each contact lens and used for that lens only. These are made on precision lathes, accurate to within 0.0004". Grinding and polishing of the front surface are done only on direct-drive machines in which the motor speed is electrically controlled. With gearing eliminated, a smooth, almost vibrationless operation is obtained from the machine.

The finished lens is checked with both a lensometer and a Bausch & Lomb keratometer, the latter for accurate measurement of the corneal curvatures. The outside scleral surface must be shaped by hand to prevent any sudden transition from the corneal to scleral portion. By making the scleral portion transparent (instead of translucent or opaque as some contact lenses have been made in the past), the exact fit of the scleral portion may be easily determined by observation.

The finishing process requires much more fineness than other plastic operations. Unlike other products, contact lenses demand the highest degree of precision in grinding and polishing, *requiring not merely artisans but master craftsmen.* (For this reason alone, the price of these lenses is likely to remain at or near the present figure of $150.) Consider the matter of polishing; Rouge and grinding laps used in making glass lenses are out of the question and new substances had to be found. They were discovered in cast phenolic polishing laps and new polishing chemicals. By the slightest modifications in polishing, the precision of modern spectacle lenses can be duplicated and the patient be assured of the same degree of accuracy in his prescription.

Contact lenses were invented in the nineteenth century as a glass shell to overcome the irregularities of surface of diseased corneas. They had no power. In 1888, Dr. A. Fick developed contact lenses to correct defective vision. He made molds from cadaver's eyes over which the lenses were blown. In 1920, Carl Zeiss ground and polished them for the first time in the famous laboratories at Jena and there were further improvements in the thirties. However, as no mold was made of the eye, a perfect fit was impossible. The doctor had a limited, though wide assortment of standard shells and selected the size and contour that gave the patient the greatest comfort by trial and error method. The fit was only approximately correct and the resultant lack of success led many to conclude that contact lenses had only a limited use. Generally, the patient could tolerate the lenses for a very short time only, as the shell pinched the eyeball at different points. In addition, there are variations in the size and shape of the cornea and the corneal portion of these lenses were of necessity made according to standard sizes that did not suit individual requirements.

The combination glass-plastic lens perfected some years ago was the first step in the new direction in that the plastic, scleral portion was molded to the eyeball. The new all-plastic contact lens not only overcomes the difficulty caused by separation of the glass and plastic, but also re-

(*Continued on page* 88)

Placing contact lens in the eye with rubber suction cup

Contact lenses may be easily removed from the eye by hand

All-Purpose Bonding

Strong, Flexible Synthetic Rubber Base Cement Bonds All Materials in Simple Process; Is Applicable to Many Fields

Plastics sheet with marble design is joined to a metal base material which has been sprayed with "Pliobond"

DEVELOPMENT by Goodyear scientists of a synthetic rubber base cement known as *Pliobond,* has made it possible to bond together any two materials with almost no regard for their physical properties. As a result, whole new fields of uses are now opened to such various applications as buildings, aircraft, automobiles, ships, trains, furniture and other structures.

Furthermore, a new method of "marbleizing" has permitted Goodyear to announce the availability, postwar, of marble-simulated material created by bonding an extremely thin layer of vinyl plastics to metal cylinders which are then finished and colored to resemble the natural stone. The particular formulation used in this application is *Pliobond* 190-C.

Prior to World War II, thin veneers of wood bonded to metal sheets were widely used for the panelling of building lobbies, offices, libraries, and the like, and for the finishing of the interiors of trains, steamships, and aircraft. The process in use, however, was relatively complicated.

However, the shortage of strategic materials which greeted this war prompted Goodyear scientists to undertake the development of a simpler way of doing the same thing. Their answer was *Pliobond.* It is now merely necessary to spread the plastics cement over the metal, put the layer of wood over it and subject the material to a 15-minute application of moderate pressure and heat in a press. Further development and research led to the possibility of bonding not only wood but rubber, plastics, cloth, or leather to any desired metal or other material. Thus, not only can wood be bonded to metal or plastics to metal, but if desired, plastics can be bonded to wood, or two sheets of metal can be bonded together.

Right, "Pliobond" marbleized sheet is easily formed into varied shapes, including small-diameter cylinders (left)

Pliobond is easy to apply, possesses high adhesion, is waterproof, and provides a non-crackable flexible bond which will withstand a temperature from −109° F, to + 170°F.

As an example of how *Pliobond* is expected to be used in building homes, it is possible to manufacture a new material for the construction of interiors consisting of a fireproof wallboard to which a plastics-coated fabric has been bonded.

This fabric is water-proof, mildew-proof, resistant to alcohol and many other solvents. It will not crack or check in sunlight and it can be cleaned with soap and water. Fabrics of any desired color or design could be used with the desired plastics before they are bonded to the wallboard.

Metal sheets to which any material has been bonded can be fabricated in the same way that a simple metal sheet is now handled. They can be bent into any desired shape without cracking loose the covering of wood or other material. They can be cut, drilled, punched, etc. When desired, other metallic units can be welded to the back of the sheet without weakening or loosening the bond.

(*Continued on page* 105)

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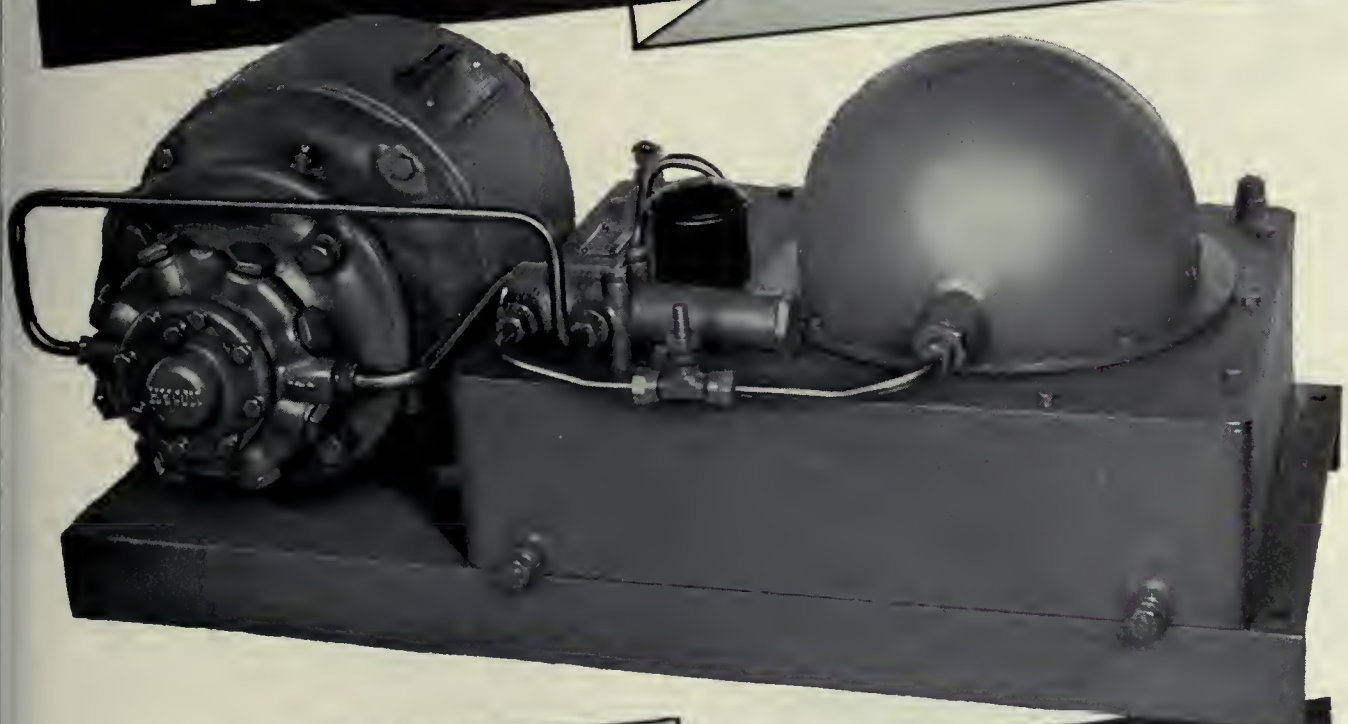

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There is no use crying over ink spilled on "Velon" upholstery. Merely use a damp cloth to remove the fluid

Velon

By P. P. Crisp

President, Firestone Industrial Products Co.

JUDGING from reports of its success in military applications, extensive post-war use in a wide range of products is promised by *Velon*, a colorful, new, unsupported thermoplastic fabric possessing a number of extraordinary qualities.

War finds use for *Velon* as a material for screening, insect- and vermin-proof tents, inner soles for jungle boots, and other special applications, making it difficult to obtain for civilian use today.

Post-War Possibilities

Anticipated post-war possibilities can be summarized as follows: Household furniture, upholstery in transportation vehicles and public buildings, wall coverings and panels, window screening, draperies, table cloths, shower curtains, mats, dresses and other garments, hats, hosiery, lingerie, handbags, belts, slippers, play shoes, luggage, ornaments, pins, buckles, costume jewelry, fishing leaders for fly rod equipment (in its thread form), industrial filters and (in flat sheet form) identification tags.

In *Velon*, manufacturers and users of a variety of products will have available a material which combines flexibility with long-aging characteristics, and ability to take designs and color, while offering high resistance to many deleterious influences.

Woven like cloth from extruded fibres of vinylidene chloride, *Velon* is considered inflammable, capable of with-

(*Continued on page* 96)

In the opinion of textile experts, "Velon" automobile seat covers will last as long as the vehicle itself

Handbags are among the many women's accessories to which this promising plastic will bring durability and color

xceptional Qualities Indicate a
road Potential in the Form of
abric, Sheet, Screen and Thread

HERE WE SEE "VELON" UPHOLSTERY, DRAPES AND (INSET) THREAD, ROPE, BELT AND PANTIES

Injection Molder

By Clarence S. Fuza

Engineering Dept., Reed-Prentice Corp.

THE present high state of development plastics injection molding machines quite remarkable, when one considers comparative newness of the commercial pr ess. Both the size and capacity of the chines have increased steadily, so that to machines of 16 to 32-oz capacity using single conventional heater are being built can be built if a priority can be obtai Only the weldability of the material and question of economy and utility impose a li on the size or weight of units which can produced.

Functionally, the injection molding chine has not changed. Dies are moun between the stationary die plate and the m able die plate. At the start of the cycle movable die plate closes and locks the against its mating half on the statio plate, enough pressure being applied in lo ing to prevent the die from opening or fla ing when material is injected into its cav The injection plunger then comes forw against a measured charge of granular terial in the feed cylinder, forcing it throu

(*Continued on page* 91)

Left, injection-molding aircraft engine exhaust pipe covers. Below, a Reed-Prentice 22-oz capacity machine

AFTER MARS...A RENDEZVOUS WITH VENUS
When Columbia turns from war . . . to peace . . . its creative skill and versatile craftsmanship will play no small part in bringing new glamour and ingenuity to molded plastics of tomorrow. For Columbia Plastics combine unexcelled engineering ability, design sense, scientific research, production technique . . . all made possible by a pioneering organization of vision and unrivalled facilities. In post war days, Columbia will continue to pioneer the road to new perfection in products of molded plastics.
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No water seepage from wood box joined and sealed with Resin X

By John Delmonte

Technical Director,
Plastics Industries
Technical Institute

Sealing Surfaces with Furfural Resins

Non-Volatile, Penetrating Coatings Are Effective on Concrete, Wood

FURFURAL resins developed by the author at Plastics Industry Technical Institute have proven an interesting addition to the family of thermosetting synthetic resins, and are already enjoying considerable use as adhesives. Other fields of application are developing, however, one of which is in the field of *surface or protective coatings, particularly for wood or concrete products.*

The protective coatings developed from furane resins are unique in the fact that they may be completely free of solvents or volatile matter. As may be expected, the coatings which have been applied from 100% liquid furane resins prove much thicker in a single application than the more conventional solvent or lacquer type of coating. The furane resin coating is in fact a 100% plastic coating, self-polymerizing on addition to catalyst. Typical concrete and wooden containers protected with this resin are illustrated in the accompanying photos.

Shortly after application of the furfural resin coating, the material sets firmly. This takes place under prevailing atmospheric temperatures, and for several days the resin continues to polymerize. When fully cured, the furfural resin offers remarkable chemical resistance to acids and most organic solvents. In water alone slabs of "Resin X" show less than 0.1% water absorption in 24 hr. This excellent resistance is carried by the furfural resin as a coating over porous wood or concrete.

Tests results shown in Fig. 1 demonstrate the protection offered to gasoline over a period of several hundred hours. The influence of coating thickness of Resin X on the water absorbed by aircraft grades of plywood may be seen in Fig. 2. Three or more coatings give ample protection. A two-coating job was used to seal some wood against aviation gasoline.

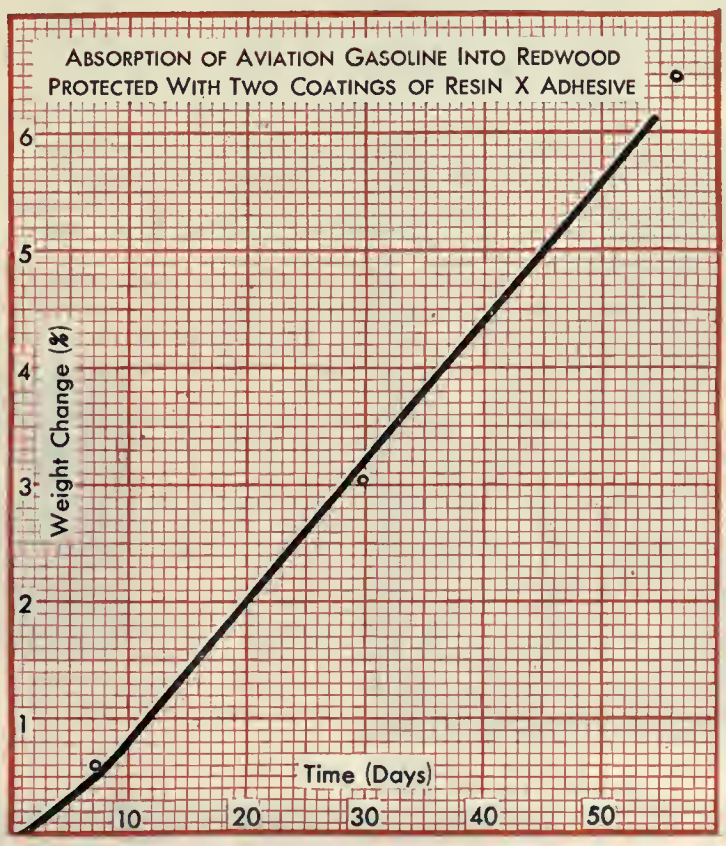

Figure 1

Surface-coating grade of Resin X forms tough film on molded plywood

What do the foregoing results imply? They indicate that 100% plastic coatings of Resin X will prove suitable for sealing concrete storage or wooden storage tanks against the loss or seepage of various fluids. Much interest has been shown in water, gasoline, and isopropyl alcohol sealers lately, and Resin X has been oustanding as protective coatings against these materials.

Another factor which should be considered in thick plastic coatings is shrinkage, for if this is pronounced, cracks may develop over large surfaces. The shrinkage in Resin X applied as protective coating is surprisingly small—less than 0.5%—which, if anticipated, may be compensated for in its application.

Protective qualities of the resin are not limited to wood or concrete alone. There are certain tanks formed of laminated plastics which find it an excellent sealer, due to its ability to wet and even penetrate solid surfaces.

Other noteworthy applications of furfural resins as protective coatings lie in the use of a special surface coating grade dissolved in acetone. This forms a tough adherent film upon evaporation of the solvent. A thin coat is deposited, comparable to other plastic coatings dependent on solvents. Wood and metal products have been so protected with this material. The photo of the curved section demonstrates a molded plywood shape protected with the aid of Resin X, surface coating grade. For absolute resistance to water and solvents, however, the 100% liquid plastic coating is superior.

At present the furfural resin coatings are limited to dark colors, although some degree of pigmentation may be achieved. This has not been objectionable, however, because the coating was developed only for industrial purposes.

The potential applications of Resin X plastic coatings have yet to unfold. Wooden and concrete gasoline storage tanks, for example, would benefit from its protection, whereas at present, they are handicapped for lack of an effective coating. Really efficient moisture barriers for wood are much in demand, and these materials may provide the answer.

The physical characteristics of Resin X cast into a plastic sheet, according to ASTM test standards, are as follows: Compression strength, 12,000 psi; ultimate tensile strength, 4000 psi; modulus of elasticity (flexure), 1,100,000 psi; shear strength (Johnson shear tool), 5700 psi; and flexural strength, 9000 psi.

Added Uses for Resin X

This material has been found valuable not only as a sealing compound, but also in molded, laminated, casting, impregnating and adhesive forms.

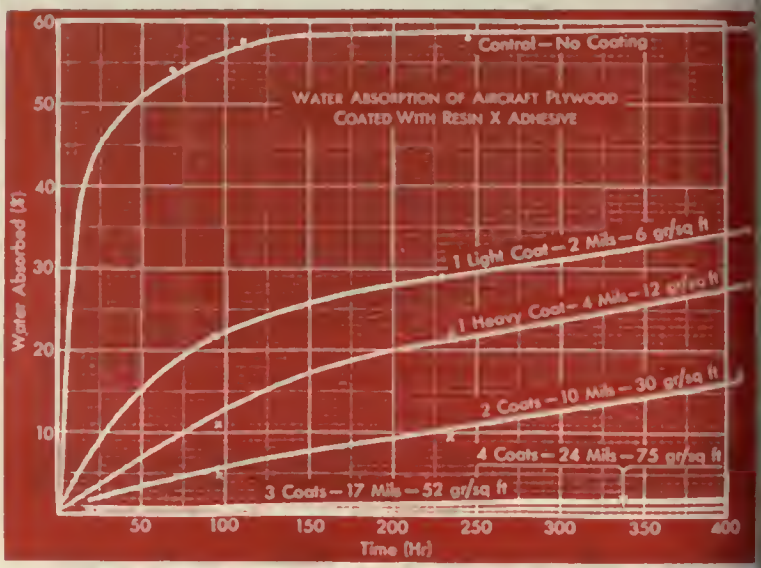

Figure 2

The aircraft industry has found considerable use for the resin as an impregnating agent for plaster of Paris. Since the dry plaster readily absorbs up to 50% Resin X, its compression strength is increased by approximately 400% when cured under the specified conditions, and its flexural strength by about 700%, in addition to becoming much more waterproof. The resin will penetrate several inches of thickness of the dry plaster. The impregnated plaster is given added dimensional stability and freedom from shrinkage, becomes hard, more chip proof and can be polished to a high luster, although its improvement in physical properties does not bring it into a class with cast phenolic resins.

Particularly noteworthy is the performance of Resin X and its companion furfural Resin XV in the field of adhesives. The latter is a low-temperature setting type, containing 50% volatile matter, while the former is high-temperature setting, contains no volatile, and is designed largely for metal products and as pre-treatment for special plastics. Great interest has been displayed in the latter, since no special heating apparatus is required. Curing is done at room temperature. This is important where the materials being bonded are affected by heat. This is true of plastic and wood products, which are subject to warpage or deformation if localized high temperatures are used. The warpage is caused either by uneven thermal expansion coefficients or by uneven moisture distribution, in wood.

Value of the resin with curved plywood sections is shown in experiments, which prove that it gives plywood much greater stability of shape than do other cold-setting adhesives employing water or alcohol.

In the experimental work done in applying Resin X adhesives to laminated phenolics having a paper or canvas base, tests on the laminate after the adhesive has been cured results in a 100% failure in the phenolic, and in some cases the laminate delaminates during the shear test. This

(*Continued on page 99*)

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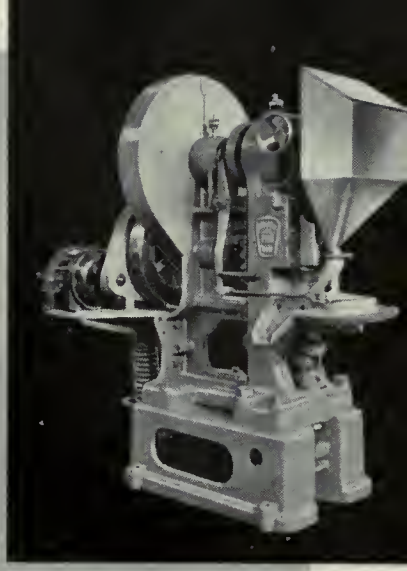
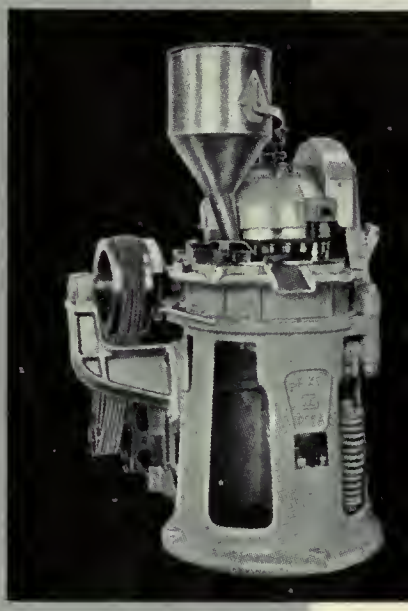
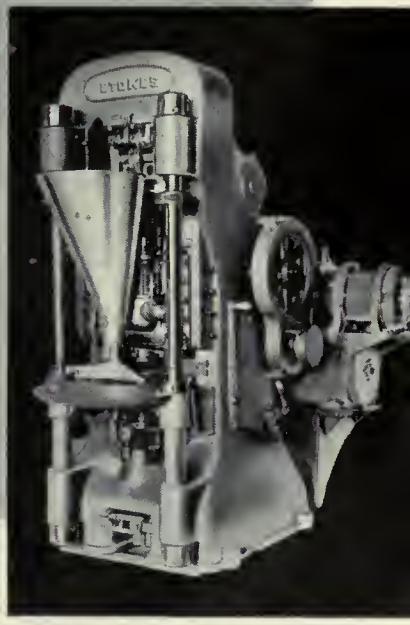


GENERAL PURPOSE



HIGH PRODUCTION



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FJS Est. 1895

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Are Plastics Meeting the Buyers' Needs

By E. Frank

Survey of Merchandise Men Shows Mixed Public Reaction To Current Plastics Products

AS one walks through the modern department store from notion counter to jewelry, from household wares to cosmetics, from furniture to toys, and many other sections, plastic goods are in evidence everywhere. The reactions of the merchandise men who buy these goods is of the greatest importance. As this survey shows, store buyers' reactions range all the way from wild enthusiasm to extreme scepticism, with most buyers manifesting healthy and unprejudiced interest in all new products. They all look at the entire industry as an infant, whose future can either be made or ruined right now and within its next few formative years.

Most of them agree that plastics have been as good or even better than the materials for which they were substituting, at times solving problems of design or construction to which no other known materials had the answer. *The greatest danger that faces plastics, in the consumer field, is the often unscrupulous use of it by manufacturers who have no ethical concern with the product they make.* Where inferior merchandise has been created, badly equipped to do its job, carelessly put together, it has been due, in some cases, to ignorance of either the properties of plastics or of the engineering problems involved in their use. Many sought to use plastics as they had formerly used metals, for which they thought they had found the perfect substitute.

Some manufacturers wanted plastics to cut costs, with no regard for either beauty or utility. They cheapened and corrupted the use of the material so that in the minds of both buyers and consumers, plastics, in its early commercial manifestations, was identified with cheap, ugly and inferior merchandise. This reputation will soon be a thing of the past, for plastics are definitely returning to the luxury fields and will take their place in the manufacture of expensive, beautiful and practical articles, as well as less costly but equally efficient goods.

Along with penny-pinching production came poor product design. This has been corrected as the best industrial design talent in the country turns its attention to plastics, and one may expect even the simplest and least expensive items, made of plastics, to bear the stamp of men such as Raymond Loewy, Henry Dreyfus, Egmont Arens and Norman Bel Geddes.

Many plastics which are being used today by manufacturers who have no other materials with which to work, should still be in the laboratory undergoing controlled tests and being perfected for future satisfactory use. Restrictions by the WPB on the use of virgin plastics have forced many manufacturers to create their products of scrap material, much of which is now also under allocation. These restrictions have required that the development of many articles will have to wait the lifting of these orders in the postwar period.

Retailers' Reactions

On the whole, retail business men feel that most plastic goods are completely satisfactory when they are made of formulae sufficiently perfected to stand the strain imposed on them. Acrylics, for instance, have been an attractive completely acceptable material in the manufacture of picture frames, cosmetic accessories and other items which, when in use, do not experience any great strain. On the other hand, as this material was first used structurally in the fabrication of chairs and tables which were not rein-

Transparent methacrylate makes an attractive carry-all, allows one to see contents without rummaging through

Equally as pleasing to the feminine eye as the transparent carry-all above are models in black or brown

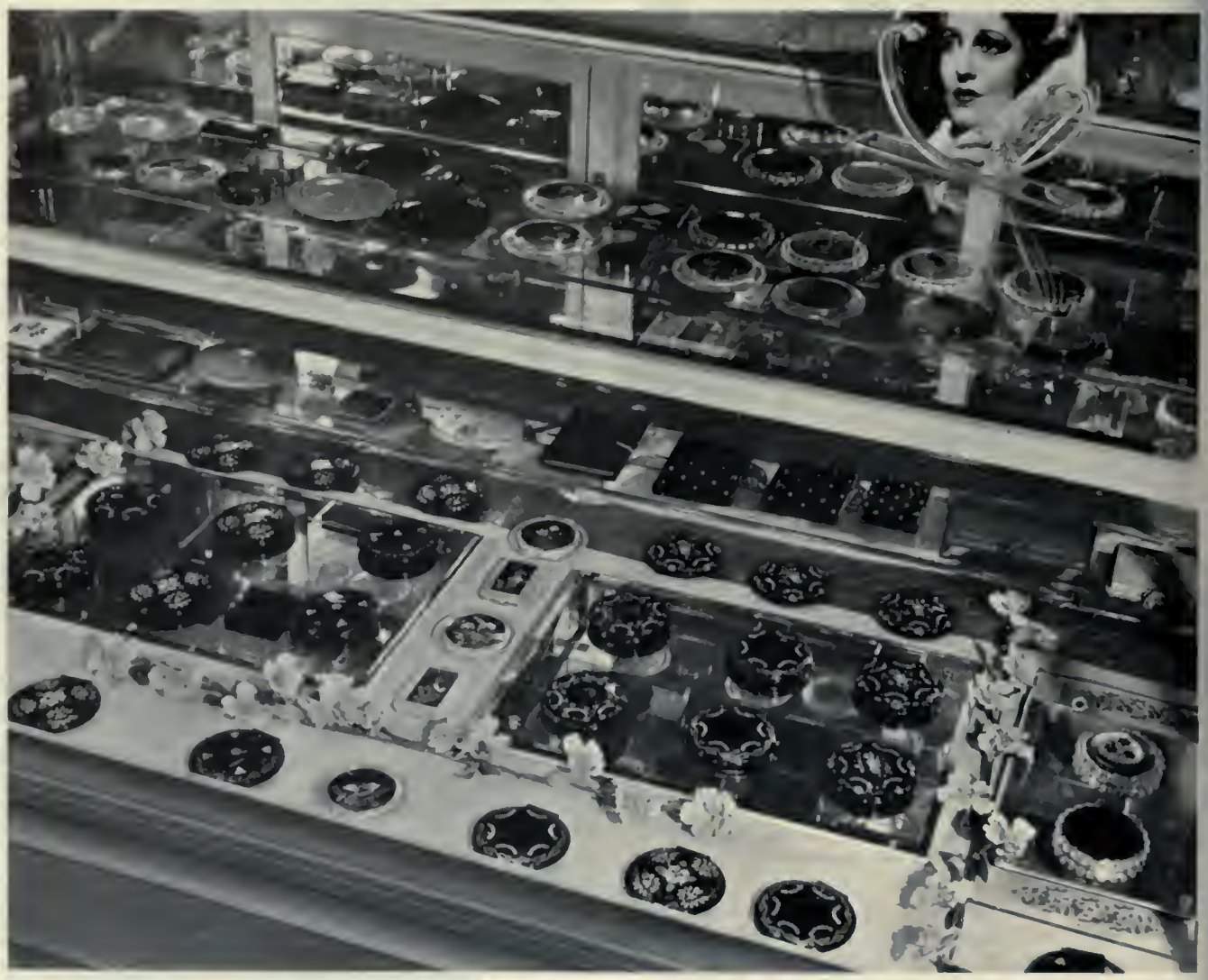
forced with metal, buyers report that it tended to break under the weight imposed. Here, they feel that the manufacturer forced a function on the material which it was not yet prepared to assume.

One of the best-informed buyers of plastic items in New York City is Charles A. Peters, of Lewis and Conger, well-known household equipment store. As organizer and president of the Plastic Club of the United States, of which many salesmen are members, he is back of a campaign to require compulsory grade labeling of all plastics products. Because of the wide variety of plastics used in manufacturing and because the consumer public does not know how these plastics are to be handled, he sees grade labeling as protection for both manufacturer and consumer. In this way the misuse of plastics will be eliminated and the customer will get the most out of his purchase by giving it proper care. Mr. Peters points out that the average customer does not know whether tumblers made of plastics can be sterilized, or whether shower curtains with protective coatings of plastics can be dry-cleaned, or whether they will mildew. The only way he can find out these and other facts is through information furnished by the manufacturer.

Without grade labeling the buyer who doesn't know plastics, but merchandises them anyway, may court trouble in the form of goods and ill will returned by dissatisfied customers. The good merchandiser, for example, should honestly tell his customers that methacrylate articles need not be boiled but can be kept hygienically clean by simple washing, since the material is non-absorbent. He must explain that although it scratches easily, it responds well to silver polish, and, if simonized, is most perfectly resistant to surface mars.

Another veteran buyer with whom the writer talked is Charles A. Gates, notions buyer for B. Altman and Company, New York. Although definitely plastics-minded, he is surprised to find that some buyers today don't even know plastic items when they see them. He stocks at least 60 items in his department which are all or partly fabricated of plastics. Garment bags, raincoats, hat, handkerchief and collar boxes, and a complete line of plastics substitutes for rubber goods, are only a few of the products prominently displayed by the store.

Mr. Gates also regrets the cheapening of some plastics, but points out that several companies are bringing to the consumer splendid articles, which enhance the reputation of plastics. As one example, he cited the plastics substitutes for rubber created by Kleinert, which are so good that he doubts whether the company will return to rubber. Their shields don't crack as rubber did; they are washable and dry quickly; they don't retain perspiration odors, and they last long, keeping their color and shape. He believes that



Counters of retail shops throughout the nation display plastic compacts in increasing numbers and styles

many articles which could not be produced of metal because of insurmountable design problems, will make their appearance after the war in plastics.

Saks-Fifth Avenue has long enjoyed a reputation for merchandising the finest goods available. Its jewelry and handbags have set many a mode. Miss Anna Monahan, buyer of handbags for the store, told this writer that the plastic items she buys prove so popular that she cannot keep them in stock. Although she buys $10,000 worth of merchandise at a time, the bags are sold almost before they reach the counters. A customer was recently so enamored of the beautiful plastics bags she saw—and they were extremely high-priced—that she bought 36 of them at one time, for her own use and to present as gifts to her friends.

The plastics patent leather purses shown by Saks for the first time this year in gleaming, beautiful fabric, are luxury priced at $32.75 each, but Miss Monahan believes that any woman who buys such a bag gets fuller value for her money, for it is not only better looking than the old type patent leather, but it will outlast it indefinitely. After months of wear such a bag shows only the slightest signs of use and it doesn't crack as does patent leather. So quickly do they go that there wasn't one in stock at either Saks or the manufacturer, Bienen-Davis, to be photographed for this article. A carryall made of methyl methacrylate, which is an exclusive with Saks and retails for $36.75, is another item of which Saks cannot get enough. This carryall is transparent and its contents can be seen through its gleaming frame. It has been seen in the smartest night clubs. Other carryalls, made by Ouvier, in brown and black as well as transparent plastics, sell for as much as $59.75.

Miss Claire Connery, Saks' buyer of costume jewelry and other novelties, stocks as many plastics items as she can get. They sell very rapidly, regardless of price, and have been completely satisfactory. She displays, beside the carryall, Rex and Plastique Co. compacts and cigarette cases, Ouvier money clips, and a wide variety of beautiful pins and earrings which sell for approximately $25 each, proving that there is a luxury market for well-made, well-designed articles of plastics.

Charles F. Stroebel, vice-president and purchasing agent of the F. A. O. Schwarz Toy Co., New York, one of the deans in the business, had several interesting things to say about the use of plastics in toys. Although there are very few toys of any kind available today, this store stocks the complete line manufactured by the Ideal Novelty and Toy Co., makers of plastics toy jeeps, planes, ships and tea sets. Although he regards plastics today as a substitute material, Mr. Stroebel believes newer and better types will invade the toy field after the war as a permanent replacement of older materials. All kinds of water-floating toys for babies and educational toys of the type manufactured by Holgate will, undoubtedly, use plastics in the future.

When it comes to replacing metal in the manufacture of

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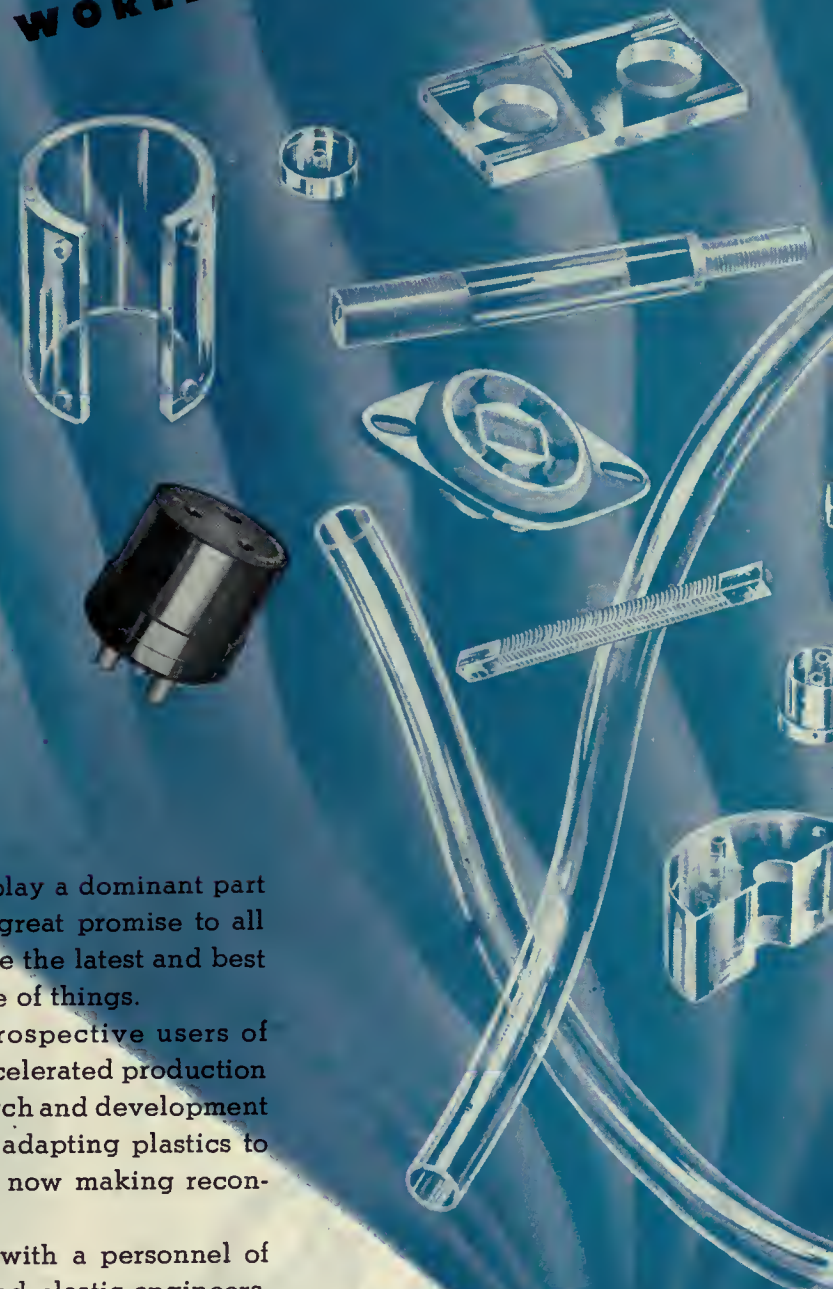

• The versatile field of plastics will play a dominant part in the World of Tomorrow. It holds great promise to all manufacturers who would incorporate the latest and best practice in their best postwar scheme of things.

Amphenol has much to offer prospective users of plastics. The experience gained in accelerated production for war, together with intensive research and development in the science and practicability of adapting plastics to industrial uses, is available to those now making reconversion plans.

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For sheer clarity and gracefulness, beauty aids made of methyl methacrylate have an impressive appeal

Cracking of certain types of plastic soles during the cold weather is a common complaint received by shoe men

Consensus of distributors is that plastics soles will not continue to replace leather on dress shoes after the war. New developments, such as the International Shoe Co. rolled-edge process, however, may considerably alter such thinking

toys, that, according to Mr. Stroebel, is an entirely different matter. Plastics do not, as yet, have the weight necessary to give such toys the substantial weight he feels they need. A child, given his choice of an identical object, one made of plastics, the other of metal, will invariably select the metal one because of this single factor, of which he is made aware by his tactile experience. It is difficult, for example, to visualize trains and track produced of light materials. [See the article on low pressure molding of toys in the August issue of PLASTICS for a contrasting opinion—ED.]

Right now the available plastics toys are being manufactured of scrap. They are being arbitrarily produced out of odds and ends of all kinds and colors. Many of the colors available—drab khaki and dirty grey—are hardly attractive or suitable for the eyes of children. After the war, color will be controlled and toys will be turned out in rainbow hues guaranteed to appeal to even the most discriminating youngster.

According to Mr. David Rosenstein, president of the Ideal Novelty and Toy Co., a subsidiary of the Ideal Plastics Corp., his company turned to plastics originally because they realized that the wood-flour composition of doll-making would soon become outmoded. They discovered that, whereas the old type doll head, which had to be dipped in color, lost all of its fine, detailed lines, plastics permitted the achievement of chiselled features. In addition to the finer effect achieved, they estimated that in time they would accomplish economies with respect to both time and materials.

Although toy manufacturers today have only cellulose acetates available and form them in a thermoplastic process, they plan, as soon as possible, to use a variety of materials, including a thermosetting phenolic in the construction of new items. Colors will be bright and the articles are expected to outperform toys made formerly of other materials. The problems confronting toy manufacturers today—warping, breakage, impure color—will all disappear. Many die makers, who are now getting the finest experience ever available to them, in the creation of molds for war uses, are expected to transfer their skills to the manufacture of fine toys after the war.

Experimentation and development of plastics for shoes has been continued on a greatly restricted scale since the war started. Shoe manufacturers turned to plastics of necessity, when their supplies of leather and rubber for soling were restricted; but today even plastics materials have been curtailed. Although plastics soles are now seen on all types of unrationed shoes and are widely sold, they have not all proved satisfactory. The merchandising manager of one of the country's largest chain shoe stores, who prefers to remain anonymous, told this writer that the trade went into plastics only because of compulsion. They soon found themselves with two pretty serious problems: One was adhesion, since the present cement in use is inadequate; the other, cracking in cold weather. This company began selling shoes with plastics soles about the middle of the year. No complaints from customers reached them until the cold December weather arrived. Beginning then and continuing throughout the cold weather, repeated samples of broken soles were turned in for exchange. Such complaints never came to their stores in Florida, where the same merchandise was being sold but where the temperature never dropped precipitously.

Another obstacle in the way of selling plastic-soled shoes is found in *the customer's traditional resistance to all composition soles*. Consumers will have to be unsold on this prejudice by the appearance, durability and other advantages of plastics shoes.

(Continued on page 89)

Designing Laminated Phenolics For Switchgear Application

By H. E. Pearson
Manager, Switchboard Engineering
Roller-Smith Co.

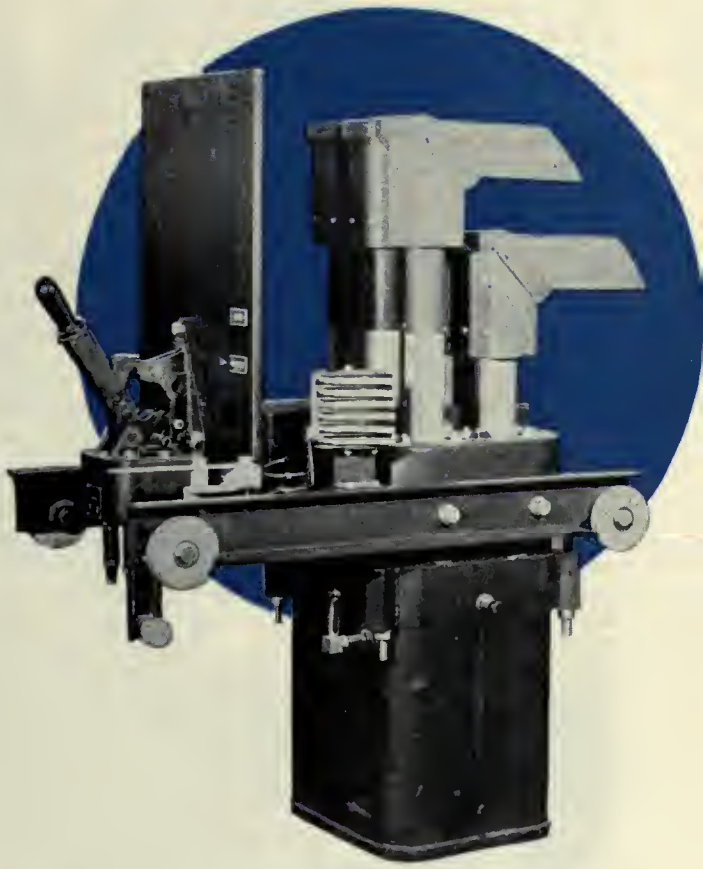
Knowledge of Electrical Properties Is Essential to Proper Selection and Adaptation of These Materials

THE high dielectric strength of laminated phenolic plastics make them ideal for the switchgear industry. They also have, or can be designed to have, adequate mechanical strength for all applications in this field emphasizing the variety of parts surrounding high voltage conductors, such as clamps, collars and supports; including bushings, molded bus bars and supports, and isolating enclosures around disconnecting devices. Space economy, safety and appearance are other outstanding merits which have recommended phenolic plastics as insulating material.

For the uses described above a distinction must be made between wood-flour or powdered-filler phenolics, which can be molded with metal inserts, and which are suitable only for low voltage applications, and the laminated phenolics, using impregnated or coated paper and cloth fillers. Only the latter are suitable for high voltage applications. They can be molded in suitable dies, the material often being macerated to gain impact strength. Although this class of phenolics can be molded around metals, metal inserts cannot be used due to the flow during the molding process.

High-impact-strength macerated phenolic used in molded collar

A molded bus bar with an integrally molded tap and joint



Oil circuit breaker with mandrel-rolled and mold-cured "Bakelite" bushings and isolating enclosures

A great variety of manufacturing processes are available to the designer of laminated phenolic plastics. Bushings may be made by rolling the coated paper or cloth on a heated mandrel. Some bushings can be mold-cured under pressure, which also adds to the density and resiliency of the material. After the removal of the flash marks, curvature to close tolerances is secured by the use of centerless grinders. Such bushings may then be machined to secure shoulders, grooves, notches, etc., for special application.

In the case of a circuit breaker, the long bushings are sprayed with molten zinc to a thickness of several mils. The bushings are made of mold-cured laminated *Bakelite*, to which the softer metals, such as zinc, adhere exceptionally well, after the part to be sprayed has been sandblasted with fine sand. Metal shields cover the other portions during this process. The zinc spray will not adhere to the natural finish of the laminate, making it easy to wipe off any surplus that may fall on the unsanded portions of the bushing.

A metallizing gun operated by compressed air is used. The zinc is fed into it in the form of wire. The bond to the *Bakelite* is mechanical. Any soft metal, such as zinc, tin and lead, will adhere well on a clean-sanded surface, and may be burnished. The harder metals, such as copper and bronze, are not suitable for this purpose, since it is possible to peel off the coating. Any thickness of metal

may be built up by means of the spray gun, but economy lies in the use of thin coatings, since the metallizing gun is expensive to use on a cubic volume basis.

Bushings with zinc spray have been in service in all parts of the country for as long as 5 years and have proved eminently satisfactory. Both 60-cycle flashover tests and 1½ by 40 micro-second impulse flashover tests have proved the efficacy of this means of design control. Similarly, tubes of any shape as well as solid rods may be rolled and molded to obtain greater density and strength.

Preformed paper-base plastics which have not reached the polymerized state may be used in combination with preformed paper or cloth base plastics to form molded products, such as isolating enclosures or molded insulated bus bars. These products are developed from a single-acting die or mold, under a pressure of 2000 psi at approximately 225° F.

Fillets play an important part in the design of these products, from the standpoint of plastic flow as well as dielectric strength. The die used for producing the latter piece is provided with die inserts for two sizes of run and three sizes of tap in any combination. Thus, 365 varieties of standard bus bars are molded from this single acting die, which transmits pressure in two directions during the molding process. This bus bar illustrates a principle seldom seen in the laminated plastics field; namely, the use of metal (copper) bars, around which the insulation is molded.

Macerated precoated linen is used extensively in the molding of parts requiring high mechanical as well as dielectric strength. Clamps and collars, for example, are made from macerated linen which has been coated with *Bakelite* varnish before macerating. Macerating gives equal strength in all directions and makes a product capable of being drilled, tapped or otherwise machined. Since such pieces are more massive, the lower volts per mil dielectric strength in the thicknesses used can be made equivalent to the strength of the laminated paper base products.

Laminated paper base plastics are molded in sheets of varying thicknesses up to 2 in. Many parts are sawed or milled from stock size sheets. Hollow-ground rotary saws and fly-cutters are the only special tools required for handling phenolics in this form. A bus bar support cut and machined in this manner and assembled into a corona-proof bus bar structure occupies far less space than the conventional porcelain supports. There is no corona glow at night with potential up to 15,000 v.

Bus bars supported by plastic material cut from stock

Isolating enclosure doors made of paper-base laminate

Another interesting application is the engraved door on isolating enclosures made of natural color *Bakelite*. It contains one layer of red paper (dilophane) on each side of the phenolic, on which the word "danger" is engraved, so that it stands out in contrast to the red lamination.

A similar principle is employed for engraved name plates, which have a natural color center, two white intermediates, and two black outside laminations. It is made of punching stock, so that holes may be punched in, and the edges can be beveled to show a white margin. The engraving is done by a standard engraving machine and appears as white letters through the black surface.

The success of the laminated phenolics as an insulating material is dependent upon the care exercised in the electrical design of the part and the care used in applying it. Since they track readily, that is, build up carbon paths from high potential points to ground, the designer must avoid all high stress points so as to eliminate the formation of corona, either audible or visible. *Bakelite* varnish coatings are often used on plastic parts to prevent discharges from tracking and aid materially in flashovers, but better results are secured from good surface gloss obtained by manufacturing control.

The elimination of corona energy is necessary, however, to good design. Metal parts, which may accumulate static charges, should be grounded by means of straps. Studs or bolts located close to high potential circuits should, in addition to grounding, have their surfaces covered or hidden by tubes recessing into the plastic parts, in order to prevent corona discharges from taking place. Rounded metal members and fillets in phenolic members are valuable means of design control for plastic parts.

The paper-base laminate employed for power frequencies in the switchgear industry is NEMA grade XX. It has a dielectric strength of about 350 v per mil flatwise and 60 edgewise. Tensile strength runs 11,000 psi with the grain and 8,000 across grain. Bond strength between laminations, however, is low, and tension in this third axis is avoided in design. Compressive strength is 30,000 psi flatwise and 18,000 edgewise. Shear strength averages 7,000 psi in all directions. END

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No. 3 in a Series of advertisements "MEET MEtal Plastics Engineering"

Phenolic Laminates in Aircraft

By Boyd C. Cole

New Uses, Properties Discovered Through War Applications Point To Broad Peacetime Expansion

Structural detail of the phenolic chin turret fairing for the "Flying Fortress"

PHENOLICS, one of the earliest known plastics, long used for electrical insulation and automobile timing gears, now are proving highly successful as chin turret fairing on *Flying Fortresses* and in ammunition chutes and other assemblies on all types of bombers and fighters.

Light, durable and flexible, the materials used bear such trade names as *Formica, Micarta* and *Insurok*.

The laminated phenolic fiber sheets which form the base of the fairings and chutes are made by placing uncured sheets of cloth or paper in layers and subjecting them to pressure and heat. After the heat has been applied the dies are cooled and the smooth, tough phenolic sheets emerge. Prior to this operation the raw cloth or paper was impregnated with a phenol formaldehyde resin and then dried until the correct amount of moisture remained. Through the heat process the phenol formaldehyde became liquid and then dried into the bonding agent between the fiber sheets.

It has only been within the last several years that a method of forming these flat sheets was developed. William I. Beach, plastics engineer, North American Aviation, has been largely responsible for the molding processes developed to form flat sheet stock.

In the early part of 1943, Army authorities decided to add a chin turret to the Boeing B-17 *Flying Fortress*, to protect the blind spot directly under the bombardier's station. It was then necessary to attach a fairing to the back of the turret to fair it into the belly of the plane and make for aerodynamic smoothness.

At this time engineers of the McQuay Aircraft Corp., Los Angeles, proposed to the Army that they be allowed to make a fairing for the turret of laminated phenolic sheets. After many tests, the company was given approval to design and manufacture a phenol fiber chin turret fairing. The fairing, subjected to rigid tests by the Army, passed the examination so satisfactorily that the company was given an order to start mass production of the unit immediately. Since that time many thousands of these parts have been manufactured and shipped to all of the plants making *Flying Fortresses*.

The fairing, which weighs slightly more than 6 lb. is composed of a skin supported by two bulkheads, two kielsons and two stiffeners. The bulkheads and kielsons are made of phenolic sheet which is formed by the same method as the skin. These parts reinforce the thin skin and support it against the pressures applied while the plane is in flight.

Since the process for making the fairings and the chutes still is a trade secret, only general information about the forming steps may be revealed. Workers, at McQuay which supplies the greatest percent of fairings to the Army, first lay a fairing pattern on a sheet of phenolic ¼ × 48 × 70" and bandsaw the uncut sheet to a fairly close outline of the finished product. Then the flat sheet,

Characteristics of "Micarta"*

Tensile strength (psi)	
With grain	13,000
Cross grain	11,000
Flexural strength flatwise (psi)	
With grain	19,000
Cross grain	16,000
Specific gravity	1.37
Water absorption (ASTM—3 × 1 × ½"— weight gain in 24 hr, %)	.6

*Grades used in aircraft parts discussed in this article.

One of 30 types of .50 calibre ammunition boxes produced by McQuay Aircraft Corp. in which plastics have replaced metal

Array of the varied aircraft parts produced by McQuay from high-strength laminated phenolics

known as the skin, is heated in an oven at the correct temperature. After the skin has been heated for 50 sec, it is immediately placed in a kirksite die for 30 sec and shaped to the general outline of the finished fairing. After removal from the die the skin is allowed to cool for 5 min before it is returned to the mill for routing and trimming.

From the trimming department it is taken to the assembly room where it is carefully inspected for flaws, fractures or dimensional errors. Now the skin, kielsons, angles, and bulkheads are placed in a drill jig and the complete assembly is drilled through a fairing pattern in a matter of seconds and passed on to the next assembly where all rough edges are trimmed and sealed. Next the parts are joined with tubular rivets and sent to the paint department where one coat of primer and several coats of aluminum paint are sprayed on the now completed fairing and allowed to dry. The kielsons, angles and bulkheads are made the same way as the skin. They go through the same forming process, except that maple wood dies instead of the kirksite dies are used to shape the parts.

McQuay company officials state that their method of post-forming the crude laminated sheet stock requires only 1/20 of the time to form a fairing by low-pressure molding the raw stock in a heated press. In addition, the dies used are much less expensive to make because they do not have to be heated.

Also made of this material were ammunition chutes. Besides being extremely light (approximately half the weight of aluminum), the chutes, when hit by an enemy machine gun bullet, will not flower as a metal chute would. A bullet passing through one of the chutes will leave a clean hole with no ragged edges, thus eliminating the possibility of jamming and assuring a continuous even flow of ammunition while in combat. Chutes now made of zinc plated or stainless steel when pierced by an enemy bullet cause an ammunition jam, therefore, another material had to be found. The laminated phenolic chute was the answer.

The company also is engaged in designing and manufacturing other armament equipment of phenolic laminate.

(*Continued on Page* 90)

Irregular shape is exhibited by these ammunition chute parts

PLASTICS AT WORK

Instead of the present large cabinet and small direct image, Barnes & Reinecke have designed this small portable plastics television set which projects a large image on the screen. Radio, dials and wire recorder are built-in

This multi-purpose combination radio and coffee table is laminated with black Micarta. There is room for records and magazines, radio and phonograph in this classic design by Russel Wright, N. Y.

Versatility is represented in this Wurlitzer seven foot grand piano model with a transparent plastics base. This sturdy musical instrument is designed to harmonize with any furnishings and surroundings

PLASTICS AT WORK

Ability to withstand temperatures from 40° below to 180° above insures the success of Tenite heat and air vent contral assemblies for use an bombers. Malded by Reynolds Molded Plastics Co.

The operation of the water meter may be observed thraugh a Lucite hausing. This is a great help in demonstratian purposes. Molded by Stricker & Brunhuber Co. for Pittsburgh Equitable Meter Co.

These inexpensive Tenite tube filters over fluorescent lamps require na transformer and da nat generate intense heat. They are extruded by Extruded Plastics, Inc.

Protectian against injury in handling and shipping af ignitian cable leads is achieved by the use of red cable tip protector caps malded fram Bakelite. Molded by Bridgeport Molded Products

PLASTICS AT WORK

Cloth coated with Vinylite resin is easily fabricated into the finished shoe. It is strong and has the resistance necessary for durability. A product of the Carbide and Carbon Chemicals Corp.

Improvement of durability and dimensional stability is achieved by du Pont in their treatment with methylolurea of shoe lasts and wooden heels. There is no discoloration or change in appearance

These dispensers for cleansing powder pictured here give the bath clever interior decoration. This is one of many applications of Libbey-Owens-Ford Glass Company's Plaskon molding compounds

PLASTICS AT WORK

. infantry throughout the world been issued this light, strong durable Tenite scabbard. A duct of the Victory Plastics Co.

The use of Tenite plastics pellets in sand-blasting equipment to remove carbon from piston walls and narrow piston ring grooves is now being used internationally by Army Air Forces in air depots

To save time, war workers pass inspection with transparent, light and attractive Celanese Celluloid's Lumarith lunch boxes distributed by Irwin Corp.

Plastic TOOLING

By Melvin Young

Plastics Methods Engineer
The Glenn L. Martin Co.

Time and Material-Saving Plastics Tools, Fixtures Have Earned a Permanent Place in Modern Production

Pouring a check block for a "Plexiglas" porthole on JRM "Mars"

ALTHOUGH still in an experimental stage, plastic tooling at The Glenn L. Martin Co., Baltimore, has already resulted in man-hour and material savings beyond the wildest dreams of Martin tool design engineers when the program was first undertaken less than a year ago. Not only are these savings being effected in the actual construction of the tools and fixtures, but in many cases they are reflected out on the assembly line where the new tools are used.

A welded assembly, for example, which formerly required from 10-15 min per part for inspection, is now being checked in less than 1 min in a new plastic fixture cast directly from an inspected part.

In the more direct matter of tool construction, eight plastic drill jigs for PBM *Mariner* cowling claws were produced in 280 hr as against 1200 hr required to fabricate similar jigs from steel for a previous model—a net saving of 920 hr, plus several hundred pounds of critical steel.

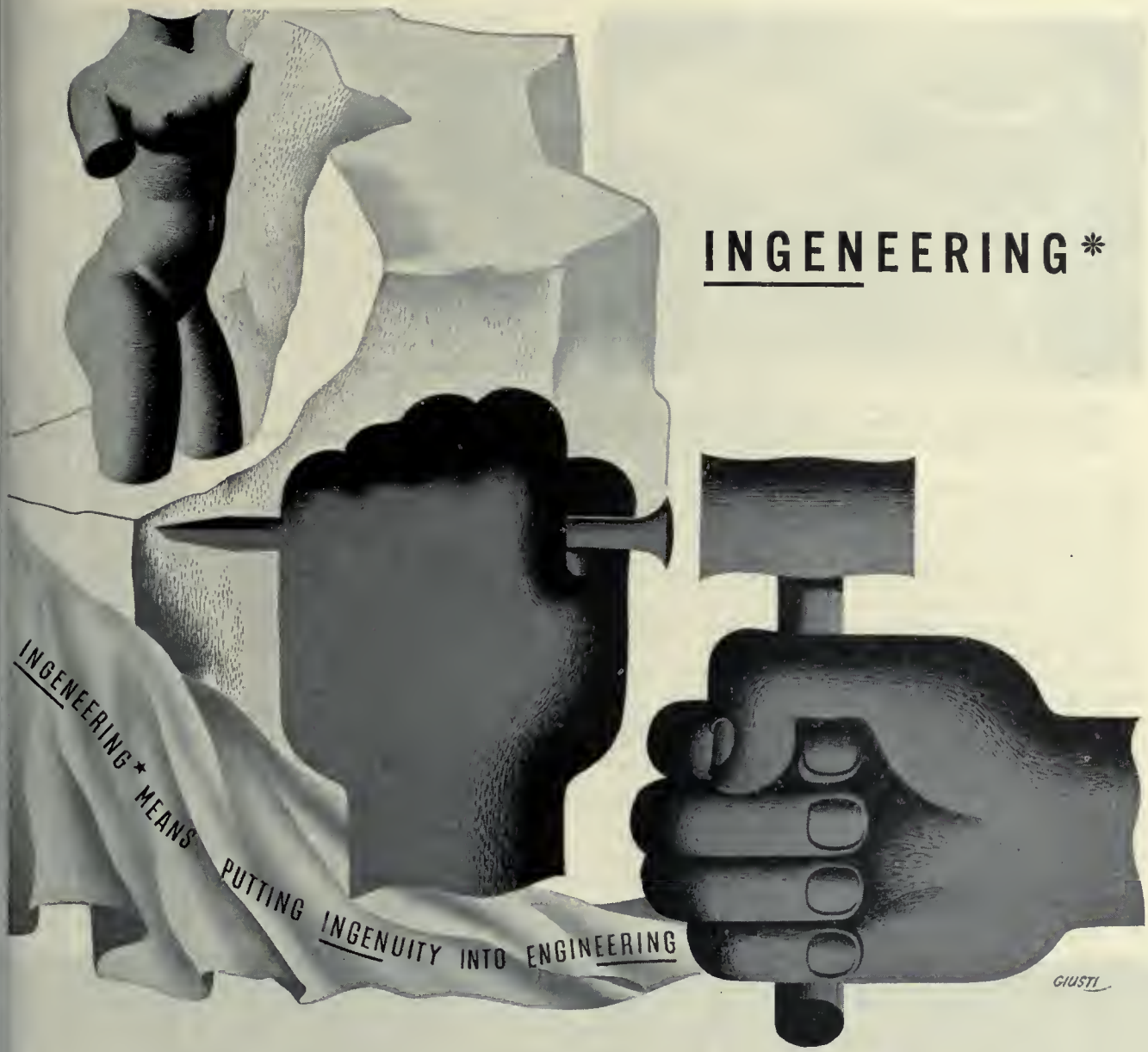
Machining time running in excess of 100 hr was eliminated by using a thermosetting resin instead of cast aluminum for a PBM accessory panel fixture.

A spotweld fixture likewise for the PBM was cast from plastic in one-third the time that would have been required to fashion the same thing from masonite.

And on the production model of the JRM *Mars*, for which plastic tooling is being used extensively, five cowling fixtures were made from plastic in one sixth the time normally required to make one steel fixture of the type formerly used, while plastic checking fixtures for formed *Plexiglas* and the pilot house opening into which it will be fitted have been cast in 25 hr per fixture as against 100 per fixture needed to make them from dural, with the added advantage that the fixtures used by the outside vendor and by company inspectors are absolutely identical in that they are cast from the same mold.

Both thermoplastic (*Plastalloy*) and thermosetting (*Textolite*, *Catalin*, *Catabond* and *Catavar*) resins are being used in the Martin plastic tooling program, but to date the bulk of experimentation and research has been concentrated on the latter type. Items made from the thermosetting phenol formaldehyde material include drill

"Catavar" checking fixture for a welded assembly beside the actual part from which it was molded



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Top (left), "Catavar" drill jig made in 35 hr by molding from sample part with bushings attached; (right), checking fixture made in 5 hr; (bottom), an assembly fixture made in 20 hr

jigs, assembly fixtures, spotwelding and torchwelding fixtures, checking fixtures for both in plant and outside vendor use, and a wide variety of small parts and miscellaneous items ranging all the way to tool item handles. Among the most interesting items were 150 propeller cuffs for the wind tunnel model of a new experimental airplane. Normally these cuffs would have been turned from laminated mahogany, but 3 to 4 weeks were saved by casting them from plastic, even though 400 plaster molds had to be made.

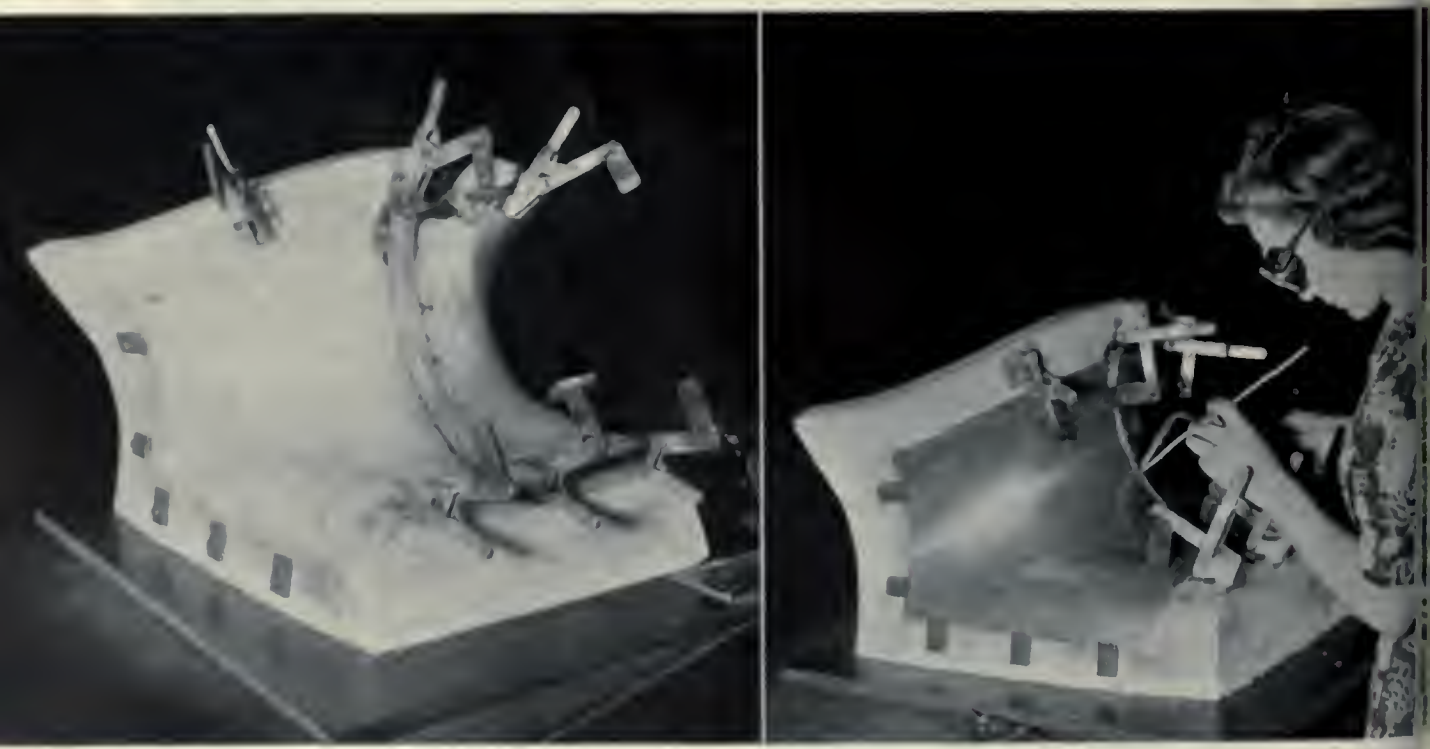
Plastic tools and parts are cast in wood, masonite, plaster of Paris, metal, rubber and latex molds, depending on the nature of the part. In many instances the plastic fixtures are cast directly from an inspected part or a plaster mold is taken from the part and the plastic tool cast from this mold. When either methods can be used, it saves not only the time required to construct the pattern, but also that needed to make templates and assemble engineering data.

General casting procedure consists of preparing the resin by heating and mixing with the proper accelerator and catalyst and then mixing in the filler—wanut shell flour, asbestos dust, fibre dust, macerated canvas, or ground pre-set plastic, and then pouring into preheated, lubricated molds and curing in an oven with a forced draft circulation. The length of time required varies with the amount of resin to be cured and the particular resin being used. *Textolite* and *Catabond* require from 8-12 hr at 60° C. while *Catalin* and *Catavar* take from 48-72 hr at 80° C. The size casting that can be handled is limited only by the size of the curing oven and the equipment available for preparing the resin.

Recently Martin plastics engineers have been experimenting with the possibility of producing transparent drill and checking fixtures from *Catalin* resins. While transparency can be obtained, it is done at a sacrifice of stability and maintenance of tolerances. However, further experiments are being conducted with additional types of accelerators and fillers.

Characteristics of plastic tools and fixtures include light weight, imperviousness to general chemical and atmospheric attack, good electrical and thermal insulation, attractive appearance and a smooth and highly durable finish. In addition to being easily molded to complicated contours, the materials can be machined under the same conditions that govern work on any dense but slightly brittle material. As a general practice it is customary to attach a masonite base to the cast to increase resistance to shock.

Turning to more specific applications, one of the most interesting and unusual is the drill jig for PBM cowling claws, an outstanding feature of which is that 50 drill bushings were integrally cast in each tool over an area of 4 ft while held within $\frac{1}{64}$" tolerances due to a unique method for controlling shrinkage. In casting these jigs, small holes were drilled in the base to which the drill bushings were attached. The resin ran down into these holes, gripping itself, and eliminating shrinkage toward



Left, "Catavar" torchwelding fixture with aluminum block in area where torch penetrates. Right, fixture in use

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Metal drill basket placed over "Catavar" jig for wing tip of A-30 "Baltimore," holding splice angle in place while skins and stiffeners are drilled and parkered together

"Catavar" upper accessory panel fixture for PBM "Mariner." This unit was originally designed to be cast from aluminum, but 100 hr of machining time was saved by using the plastic

the center, while interual stresses were kept within bounds through the use of a low shrinkage material.

A wide variety of drill jigs with bushings likewise cast in place has also been fabricated by the simple expedient of drilling a sample part and attaching the bushings to it—then casting the jig directly from the part. Such jigs have proved so accurate that the inspection department now uses them as check blocks for inspecting outside vendor parts.

Another interesting plastic drill jig was developed for the A-30 *Baltimore* wing tip. A master form was built up out of wood and a plaster cast in two parts taken from this form. The stiffeners were then built up on the insides of the cast with plaster of Paris, and the cast was then lacquered and assembled together. Plastic material was next cast in the plastic mold, and the entire mold cured for 72 hr at 80° C. After curing the cast was removed from the mold and the base planed level on a planer. Following drilling, tapping and attachment of a masonite base, it was sent to the tool room and a drill basket was built around it. Inspection was the final step and the new tool was ready for the shop.

In use, stiffeners were attached to the fixture in the provided recesses with masking tape, and skins were fitted to the plastic jig by means of locating pins, the solid contour of the fixture permitting overall location of the entire skin, and the splice angle was installed. The drill basket was then placed over the assembly form holding the splice angle in place and located by pins in the base of the fixture. Next skins and stiffeners were drilled and parkered together, ready for spotwelding.

Still another form of plastic drill jig that has accounted for substantial man-hour savings is the sample pre-formed drill jig housing that is cast from a permanent mold, and from which the finished jig can be made as needed in from 1 to 2 hr by simply cementing in bushings where required with a low melting point alloy.

Assembly tools made from the thermosetting resins have ranged all the way from locating fixtures, which are

PBM cowling claw drill jig cast from "Catavar" with bushings integrally cast in the jig. Fifty bushings were cast over a 4-ft area with 1/64" tolerance maintained. The total time saved in this way was 115 hr on each of the eight fixtures

cast from a sample part and can be prepared in as little as 20 hr, to spotwelding and torchwelding jigs. The latter presented somewhat of a problem in that the torch burned the plastic material. This has been overcome, however, by the simple expedient of integrally casting an aluminum block in the plastic in the area where the torch penetrates. Prior to this development, all torchwelding fixtures were made of metal and kirksite.

Probably the greatest overall saving by the use of plastic has been accomplished through a wide variety of checking fixtures, where the ability to cast the tool from a sample part, and the easy and accurate duplication of identical tools has slashed great chunks of time off the man-hour budget.

Where tubing is bent to contours, for example, close tolerance checking fixtures for the inspection department are made by first bending one tube according to bend data, and then casting the fixture directly from this sample part. This method is sure, quick and accurate, with possibility of error being eliminated to such an extent that semi-skilled workmen can now do the same job formerly done by highly skilled tool makers in less than half the time formerly needed.

The same principle is similarly applied to checking fixtures for welded assemblies, where the plastic tool taken directly from the sample part checks angle of degree, contour and relation of the tube to the welded details in a matter of seconds.

Plastic checking fixtures for formed *Plexiglas* parts are playing a major role in the JRM contract. Here a master mold is prepared from which three identical fixtures are cast, one serving as a master fixture, a second for the outside vendor and a third for company inspection. Total times savings resulting from this procedure as compared to the old method of making each of these fixtures individually is 200 hr per fixture. Because of the high flaw-free finish of these plastic checking fixtures, the possibility of scratching the surface of the *Plexiglas* is virtually eliminated—in fact, in some cases vendors are actually using these checking fixtures to form the *Plexiglas*.

Another recent application of *Catalin* plastics at the Martin Company has been hydro-form blocks for the hydro-presses. As in the case of the checking fixtures, these form blocks are cast from a sample part. Not only does this permit easy duplication, but it provides allowance for spring back which is often incorporated in a part of this design. Since the steel block is the finish form and check block, it is not advisable to make allowance for the spring back in the steel die. On the other hand, a formed sample part may have the spring back incorporated into it, and then with the aid of a plaster of Paris wall, the liquid plastic can be poured into it as a mold

(*Continued on Page* 100)

Plastic 12-lb spotweld fixture for PBM cowling made in 1/3 the time required for a similar fixture of masonite

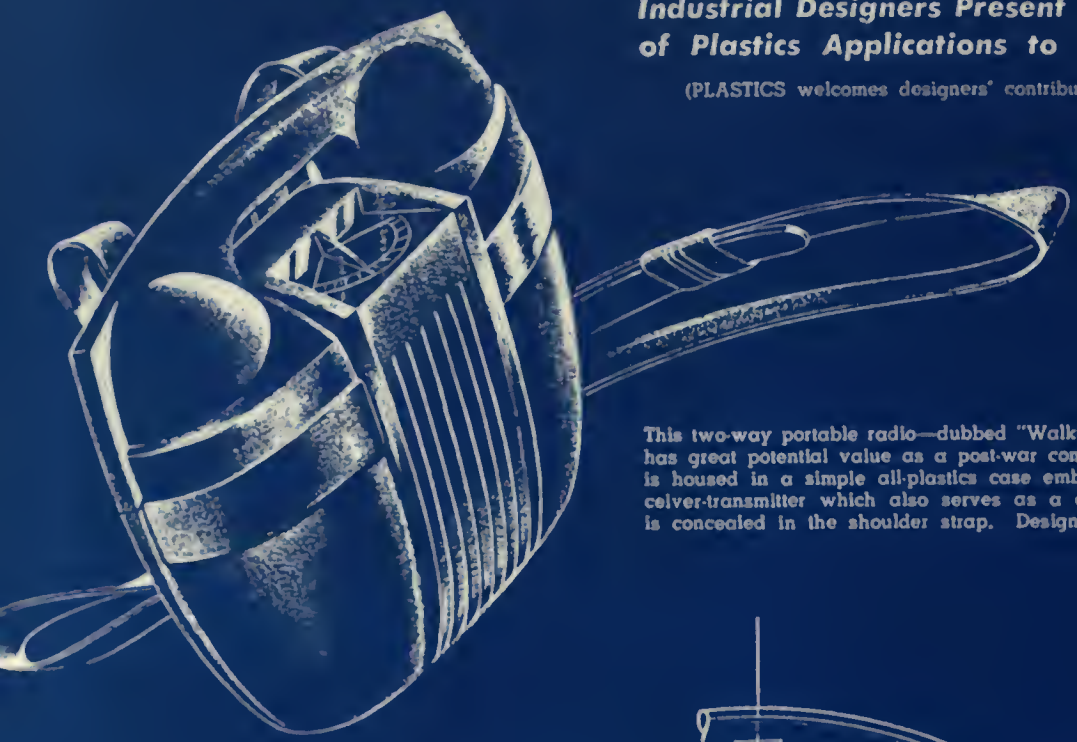
Checking fixtures for "Mars"—left, frame to check the pilot house frame opening; right, to check formed "Plexiglas"

"Catavar" propeller cuffs for experimental wind tunnel model plane. Time saved on the 150 units made is estimated at from 3-4 weeks

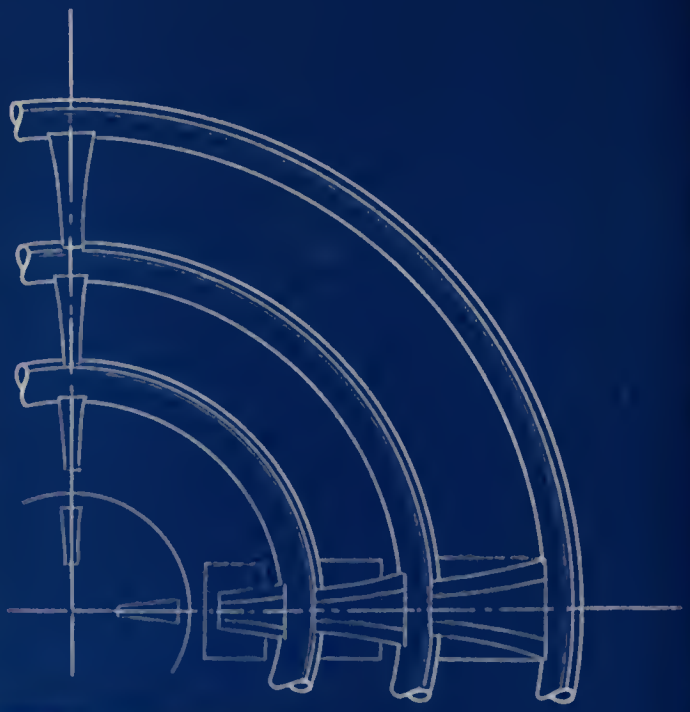
ON THE DRAFTING BOARD

Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

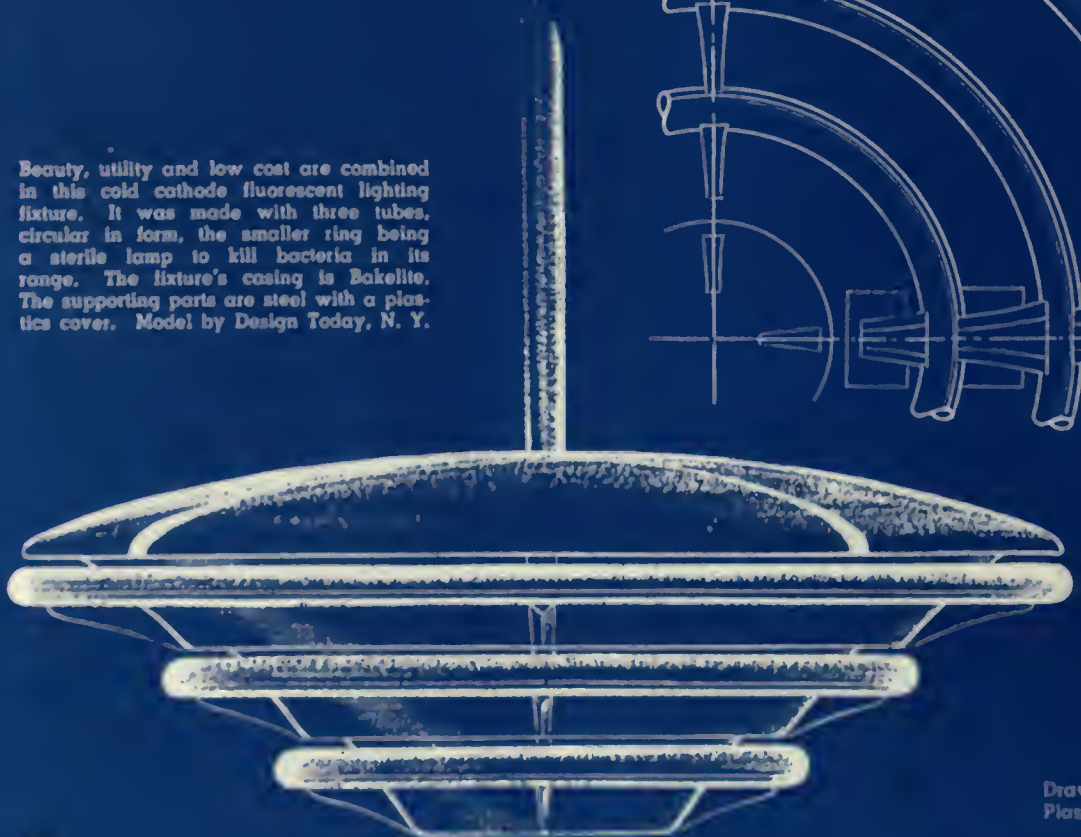
(PLASTICS welcomes designers' contributions to this department)



This two-way portable radio—dubbed "Walkie-Talkie" by our fighting men, has great potential value as a post-war commercial product. This version is housed in a simple all-plastics case embodying a "hand-set" type receiver-transmitter which also serves as a carrying handle. Its antenna is concealed in the shoulder strap. Designed by Sundberg-Ferar, Detroit



Beauty, utility and low cost are combined in this cold cathode fluorescent lighting fixture. It was made with three tubes, circular in form, the smaller ring being a sterile lamp to kill bacteria in its range. The fixture's casing is Bakelite. The supporting parts are steel with a plastics cover. Model by Design Today, N. Y.



Drawings by Julian Krupa, Plastics' Art Department

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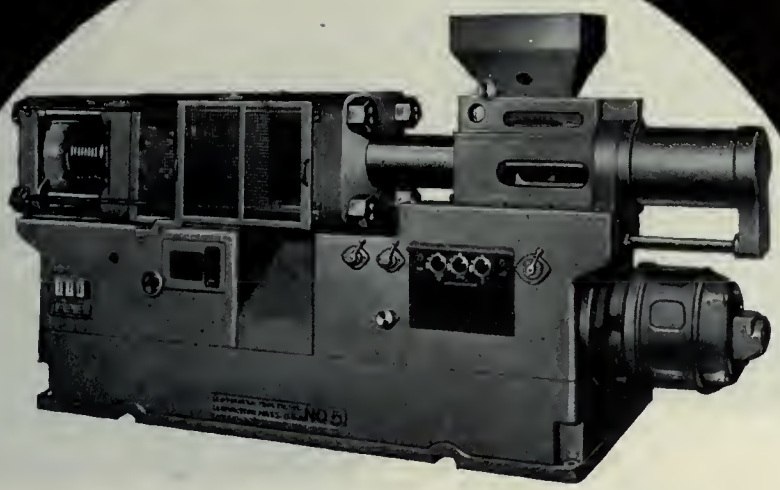

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Having Passed the Acid Tests of War, Plastics Prepare to Move Ahead on Numerous Peace Fronts

Plastics Hold Their War Gains . . .

SCIENCE and invention nurtured by a nation at peace have always proved useful to a nation at war, and it is equally true that science and invention created to satisfy military needs often have their beneficent application when peace returns. Certainly this will be the case in the field of plastics when World War II is over. Both consumer and industrial goods will gain from the research stimulated by the requirements of our armed forces.

Not that anyone in the service was interested in developing plastics as such, for the business of the War and Navy Departments is simply to wage war as efficiently as possible. But it happened that plastic products could contribute to that end far more than had been anticipated; and it was for that reason that the Army Service Forces and Navy undertook research along many lines.

Although a certain number of peace-time products entered into the war picture from the start, plastics really were given their first big play in the Army as substitutes for rubber and the metals which were on the critical list. Plastics were substituted for rubber compounds in the coating of raincoats, in combs, and for metals in razors, faucets, knife and machete handles and many other articles.

While they definitely moved into an important role early in the emergency, plastics were not wholeheartedly accepted by all industry until it was demonstrated through actual field—and later through combat—trials and tests, that they were not merely an understudy, a second-best, but superior in many instances to the items made from

Four plastics processing bags, two of which contain plastics filters, are part of the equipment in this device which converts sea water into drinking water

Use of transparent plastics makes it possible to produce training aids such as this (panel for the CG4-A glider), with most instrument operating parts visible

other raw materials which they replaced. Some well-known examples of this are the plastic buttons which have saved thousands of pounds of vital metals, yet are doing the job better; the shaving brush with nylon bristles, set in phenolic, which will outlast any bristle brush; shoe soles, which are good for much greater "mileage" than conventional leather soles; and the vinyl-coated raincoat.

A Growing Array

The diversity of plastics procured by the Army Service Forces is amazing—and the list is growing steadily. The Quartermaster Corps alone, charged with procurement of virtually all food and clothing items and most of the personal equipment used by the Army, is buying some 100 items made entirely or predominantly of plastics, and some 500 more are plastic in part.

In 1943, these items procured by the Quartermaster corps required some 75,000,000 lb of plastics raw materials for their fabrication. When one considers that the only plastic items the QMC was buying in any quantity a short 3 years ago were buttons and handles for tooth brushes and shaving brushes, the development of all these new uses seems little short of phenomenal.

But these are only wartime applications. In the post-war world there are many uses to which items developed by the QMC may be applied. For instance, one of the greatest fields is that of plastic film as a protective covering for textiles. Much work had already been done before the war, but the Army's requirements for certain uses are so much more rigorous than those for civilian articles that it had to initiate fresh researches. The plastic-coated raincoat developed as a result, proved more desirable than the rubber raincoat because of its lighter weight and because it conserved our limited rubber supply. But it is not as flexible at low temperatures, and so studies are being made for a plastic formula which would overcome this handicap.

Applications Expand

The knowledge gained in these and other experiments was also applied in the making of ponchos, covers for rifles and other small arms, waterproof bags and food packaging, the latter pointing up another fertile post-war field.

Other forms of protective coating developed for war-

As a training aid, the Army Air Forces have developed these transparent plastics cases for suction gages and altimeters to permit students to observe the units while in actual operation

Above, cam and rotary selector switch for aircraft control surface operation, with "Bakelite" parts, weighs less than 4 oz and passes severe functional tests. Below, a precision-engineered throttle valve, also made of "Bakelite," controlling fuel mixture for outboard motors on various military vessels

time needs will fulfill peace-time needs. The Army urgently required a lining for both water tanks and fuel tanks to guard against corrosion of the container and the contamination of the liquids; plastics have been developed and made to meet the exacting specifications, and knowledge of how to apply them so they will "stick" has been gained.

The QMC also developed a *Vinylite* flotation bladder, sealed around the edges, with a mildew-proof cotton duck fabric covering. This bag is used by a soldier for buoyancy in crossing a stream, or going ashore from a landing craft. On land, it may be used as a water carrying bag. Its post-war possibilities as a flexible container for liquids seem almost limitless.

A new call for outer coatings came from the armed forces even as these new bladders were being perfected. One striking result in this direction has been achieved in a protective plastic paint for coating cans of food against deterioration.

Early in its procurement program QMC purchased

Base and dial of this clinometer, produced for the Navy Bureau of Ships by Fee & Stemwedel, are compression-molded in one piece from "Bakelite." The instrument "trims ship" while loading supplies or shifting ballast

large quantities of plastic buttons which, while not strictly a war development, have become a vital item of the American soldier's equipment. In the past year and a half they have largely replaced the brass variety on uniforms. Plastic buttons are not new, but the stimulus given their use by the Army application may well increase their post-war popularity to a much larger degree than they would have achieved under normal peacetime developments.

In addition to the ornamental button, with a design molded or cast into it, the ordinary "sewing hole" button made of plastic has been produced in multiples of millions for Army clothing use.

The Army, through QMC research, also has developed the plating of plastic buttons and badges with gold and silver. Best known of the applications of this process is the lapel button now being issued to honorably discharged service men of the current war. These buttons have been purchased in quantities exceeding 4,000,000 already.

In connection with this plating operation, it has been found that plastic bases may be coated electrolytically with virtually any metal—a discovery which will undoubtedly find many uses in the post-war world.

In the field of plastic musical instruments, QMC has done pioneer work. In many camps, reveille is sounded on a plastic bugle: the plastic fife adds its trills to the march, and in leisure moments soldiers entertain themselves and each other on plastic ocarinas and "tonettes." All of these should find a ready market in peacetime, for their tone is as good as the metal, ceramic and wood items which they replace. The bugle is equally as sturdy as its brass predecessor, more resilient to shocks and jolts. The fife is said to have a wider tonal range than the metal fife. While there have been no experimentations with other instruments molded in plastics, there are those who foresee the day when plastic clarinets, flutes, trumpets and even "trombones"—in fact, the term "brass" band will become a misnomer.

Only a few groups of products developed by the Army have been touched upon in this article. Of the hundreds of other individual articles used by the Army—lenses for goggles, zippers, canteens, mess trays, faucets, combs, transparent envelopes—it can be said that the great majority will certainly go over into peacetime production, and that only a small number are likely to lose ground to the metallic articles they replaced. The plastic mesh insoles which aerate the feet of marching soldiers in the

Airtronics PREHEATERS SPEED PRODUCTION 5 WAYS

- ✓ cut preheating time
- ✓ reduce closing time
- ✓ slash curing time
- ✓ lower molding pressure
- ✓ eliminate gassing molds

The finished generator slip ring and a unit cut through the center to show the two metal rings and the insulation between them—that make this molding a difficult one to handle.

A few weeks' operation of their first AIRTRONICS Preheater convinced Wilcox Plastics Molding Co. that the over-all savings justified two additional machines—because "it became apparent that additional such equipment would greatly increase and improve our production."

Besides the savings mentioned above, and in detail shown at the right, they now deliver 35% more generator slip rings *per day*. They are making further savings: dies last longer, the finishing of the slip rings is easier, rejections greatly reduced.

Your plant can enjoy similar improvements in production by installing AIRTRONICS Preheaters. Install just one, and find out for yourself. In practically *every* instance where plants have done this they have reordered one or more machines shortly after receiving their first unit—proving that AIRTRONICS Preheaters DO THE JOB, and ARE MAKING PROFITS for the plants using them.

Rated output of Model CB is 4000 B.T.U. per hour. Send for descriptive literature showing the simple controls, self-aligning output electrodes, safety devices and other advanced features. More powerful AIRTRONICS Preheaters also available.

Write Dept. P

O'KEEFE & MERRITT GENERATOR SLIP RING

Material: Durez 1544; with laminoted phenalic spacer molded-in.
Dimensions: 4" diameter, 1⅛" thick.
Weight: Preform—5½ oz.; total finished including inserts—2 lbs.

Former Method	Operation	Preheating by AIRTRONICS
Infro-red 3 min.	HEATING PREFORMS	20 sec.
1½ min.	CLOSING TIME	34 sec.
5 min.	***CURING TIME***	**2 min. 15 sec.**
165 tons	PRESSURE	60 tons
Necessary to gas mold	REMARKS	No gassing necessary. Denser finished product.

Airtronics MANUFACTURING CO.

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5245 W. San Fernando Rd.
Zone 26

"Lumarith" dummy .45 cal revolver molded by Cruver Manufacturing Co. over metal insert to insure same weight, balance as original model

The A-78 message container, which can be thrown out of a fast-moving plane from heights exceeding 500 ft, weighs only 12 oz. Outer tubes of fibre are protected at both ends by tough, transparent "Lumarith" caps which cover light bulbs that permit location at night

Assembling the M-52 trench mortar shell, whose detonation is timed by a plastic fuse. Formerly of aluminum the new fuse saves nearly 1 lb of metal per unit

jungles and help to prevent athlete's foot and other fungus growths, should find a place in the shoes of the golfer, the tennis player, and other sportsmen. The liners used in the doughboy's helmet had found an application in miner's and firemen's headgear even before the war, but the improvements in strength which have been made in the soldier's headgear liner will be carried over into post-war developments for civilians.

In this article, products have been dealt with primarily; processes have been referred to only casually. The article, however, would be far from complete without a mention of the extrusion process. Extrusion has produced extremely thin plastic films—about 2 mils thick—for covering of rifles and other small arms in landing operations. Previously, the thinnest films which could be produced were some 10 mils thick.

Nor has anything been said of fundamental researches which were, and are, being carried out, such as those on new plastic films, to study the effect of the length, distribution and branching of the molecular chain on their mechanical properties and permeability characteristics. Obviously, successful experiments of this nature will be highly useful in post-war manufacture of film materials and their application, particularly in the packaging field.

Even from the foregoing telescoped survey, it is plain that all this work is the creation of many talents. More than 200 important industrial engineers and scientists have been serving in the Research and Development Branch of the Military Planning Division, Office of the Quartermaster General; and at least a hundred industrial executives have cooperated with them. From this group, plastics problems have received the attention due them.

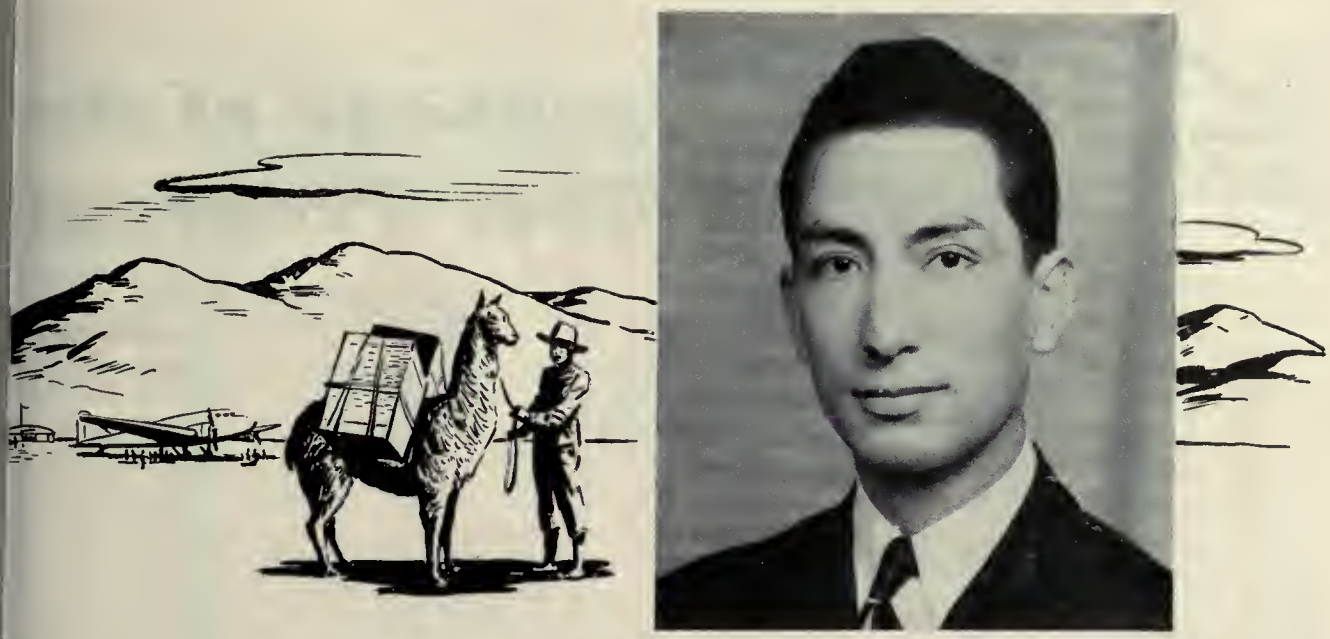
Navy

The role of plastics in all departments of the Navy is more than a source of pride. It is also a source of encouragement, for it is said on good authority that by far the largest number of war applications, perhaps 90% of them, will be retained in the future, with possibilities for use in many industries.

The fact that so many wartime applications will be permanent is all the more significant since *Navy specifications in many cases do not call for plastics only, but simply allow plastics as one of several optional materials.* Originally, these alternatives were given in order to allow the substitution of plastics for critical materials. Thus, at an early date, the Navy used plastics for compass pedestals and megaphone fittings in place of brass, for chart boards and first-aid kits in place of aluminum, and for magneto components and cafeteria trays in place of hard rubber. (Incidentally, all natural rubber has been eliminated from ships in favor of the elastomers and plastics.) Plastics also found early employment in the Navy for shelving, ventilating ducts and air conditioning systems, and rigid conduits for the installation of electrical wiring.

When it was found that a large number of both Navy and civilian personnel were being injured by fragments of glass sent flying by enemy bombing, a laminated plastic glass braced by wire mesh was developed. This material, 0.030" thick, stood up unshattered by 150-lb bombs dropped at a distance of 8 ft. In tests made by the Bureau of Yards and Docks, a quarter-pound ball dropped 20" smashed ordinary glass and cracked safety glass, leaving a sun-burst pattern. But it required a ball eight times as heavy, falling from a height of 42", to penetrate the plastics-glass laminate; and then the hole was clean-cut, without shatter.

(*Continued on page* 106)



GOOD NEIGHBORS LEARN GOOD PLASTICS

The new generation of our Latin American neighbors is vitally concerned with the industrial future. Typical is Fortunato Portilla Delgado, a successful young businessman of Arequipa, Peru, who realizes the importance of plastics in coming developments and has come to America to study at Plastics Institute. Señor Delgado feels that a knowledge of plastics is mandatory to an intelligent approach to future manufacturing procedure in his country.

It is gratifying to us that students have come from many parts of the world to study at Plastics Institute. It is an indication that the training we give is valuable not only to the student, but to the industry he serves. We shall continue to expand our comprehensive and practical training, enabling our graduates to make a real contribution to the development of the plastics industry. Inquiries regarding our resident and home study courses are invited.

Plastics

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Francis A. Gudger, President — John Delmante, Technical Director

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Styrene—Backbone of the Rubber Program

By Gerald E. Stedman

Pure styrene is produced by Dow Chemical Co. in these finishing plant distillation columns

Expanded Plant Facilities for Buna S Ingredient Broaden Post-War Source for Popular Polystyrene

Parts of crystalline clarity, some transmitting light around curves, are produced by Plax Corp. from polystyrene powder supplied by various firms

STYRENE, basic raw material for the production of the popular thermoplastic, polystyrene, has made one of the outstanding contributions to the war effort through its part in the manufacture of Buna S synthetic rubber.

When the United States early in 1942 found itself with only sufficient natural rubber to last through 1943, even with the most restricted rationing, synthetic rubber had to be substituted in a hurry. Buna S, a copolymer of butadiene and styrene, was chosen for the bulk of this program.

Buna S is produced in copolymer plants operated by several large rubber companies by reacting styrene and butadiene in the ratio of about 1 to 3 by weight. The styrene is produced from ethylene and benzene, while butadiene is the product of alcohol or petroleum. The Dow Chemical Co. produces about one-half of all the styrene through its plants in Michigan, California, Texas and Canada, and three other chemical firms manufacture the remainder in West Virginia, Pennsylvania and Texas, two of them using the Dow process.

Prior to the American rubber crisis of 1942, styrene was being used primarily to make polystyrene. Today, however, both styrene and butadiene are both being produced in staggering quantities, almost entirely for Buna S. Rela-

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- **MOLDING COMPOUNDS** . . . Complete line of Phenol-Furfural and Phenol-Formaldehyde molding powders.
- **CEMENTS** . . . Bonds of remarkable strength for metal, wood and thermoset plastics. Cold-setting boil-proof plywood and wood bonds.
- **ADHESIVES** . . . Hot and cold-setting, for plywood, poper, glass, cloth ond fibre; textile sizing and proofing; paper manufacturing, also, for wet strength ond proofing purposes.
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High-frequency radio coils and tube socket designs based on Dow "Styron" (polystyrene) and its high dielectric strength

tively minor quantities of styrene are now going into high-priority polystyrene production for the Army and Navy. After the war a very large styrene production will probably continue going into Buna S production, while at the same time, an increasing production will begin pouring into the plastics market. Butadiene will probably continue to be used almost entirely for synthetic rubber.

Styrene has been known to man since 1831 when Bonastre first isolated styrene by distilling liquid storax where it occurs in mixture with various cinnamic derivatives. Polystyrene, one of the oldest synthetic resins and a currently popular thermoplastic, has been known almost as long, having been prepared in 1839 by E. Simon. Practical usage of styrene and polystyrene, however, came only after nearly a century had elapsed. Dow development work on styrene began in 1931, and by June, 1935, commercial production was under way in Midland, Mich. October of 1937 saw a new ethylbenzene dehydrogenation plant swing into production in Midland to be followed in November by a new full-scale finishing plant which produced 50,000 lb of styrene that month.

At Midland in 1940 new type dehydrogenation units and more efficient equipment were introduced into the finishing plant. The years 1941, 1942, and 1943 each saw addition of more dehydrogenation units, and 1943 saw another finishing plant and two more ethylbenzene plants join the parade in Midland.

When the call for huge new synthetic rubber plants came in the Spring of 1942, Dow was called on by government agencies to build and operate for the government three new styrene plants, two in the United States and one in Canada operated for Polymer Corp., the Canadian Government agency responsible for that country's rubber program.

Some idea of the size of the Velasco, Tex., plant is shown by the steam, electric power and water load of the plant. Heat in the form of steam is supplied in an amount sufficient to take care of all heating and cooking for the residents of an average American town of 25,000 people, electric power sufficient for 50,000 people, and water sufficient for 300,000 people. The water is recirculated through a forced draft cooling tower, however, and thus only about 5% is lost.

The fundamental chemical reactions involved in this plant are:

(1) $C_2H_4 + C_6H_6 \rightarrow C_6H_5{-}C_2H_5$, or ethylene gas reacted with benzene to give ethylbenzene.

(2) $C_6H_5{-}C_2H_5 \rightarrow C_6H_5{-}C_2H_3 + H_2$, or ethylbenzene, a liquid, submitted to dehydrogenation, resulting in styrene, a liquid, and free hydrogen which is exhausted into the air.

Benzene is obtained from Pittsburgh steel mills, being a by-product of the steel blast furnace coke oven, and is barged to Velasco via the Mississippi Waterway and Intracoastal Canal Systems. Ethylene gas made from petroleum, comes to Velasco through the pipeline from Texas City; ethylene is produced by cracking refinery or natural gasoline plant gases.

These basic materials come to inventory at Velasco to

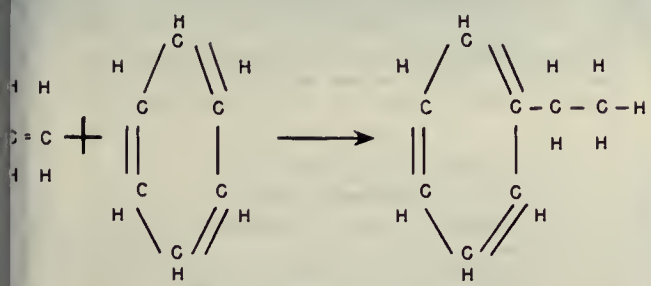
These "Styron" screw-on caps for acid and alkali reagent bottles are produced in varied colors to identify contents

All parts of this juice extractor are made of polystyrene

"Styron" instrument and door panels for refrigerators

supply four series of plants, each of the series known as a train, its three plants consisting of: (1) ethylbenzene production; (2) ethylbenzene cracking and (3) styrene finishing. Each of these trains can operate independently of the others. The 12 plants of the four trains involved are spaciously located to isolate any possible hazard, for the materials being handled are highly inflammable.

Each train involves three processing steps in a series, each occupying the facilities of a single plant. The first plant accomplishes the chemical phenomenon:



Ethylene + Benzene = Ethylbenzene

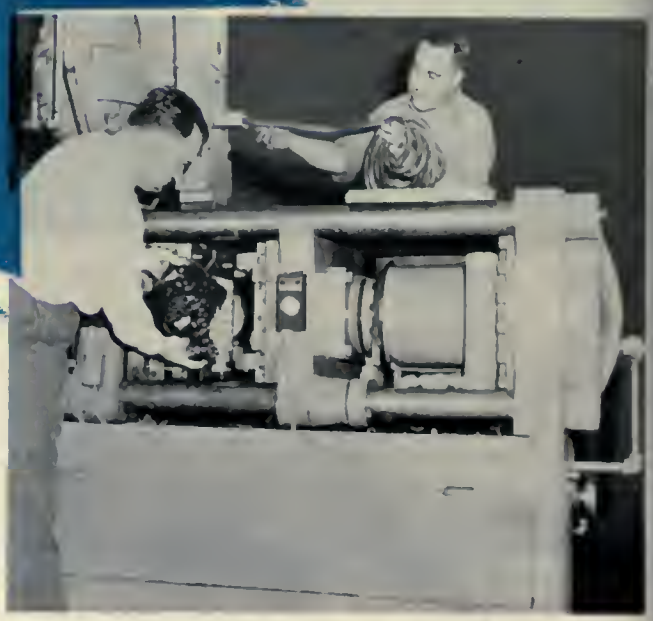
For this reaction, ethylene gas is bubbled into benzene liquid in large reactors known as alkylators. A catalyst is employed to bring about the reaction. Some diethylbenzene and other polyethylbenzenes are formed along with ethylbenzene; hence the alkylate liquor from the reactors must be distilled to separate into fractions the unreacted benzene, the ethylbenzene, and the polyethylbenzenes. This distillation is accomplished in conventional bubble plate columns varying in diameter from 4 to 7 ft and in height up to 80 ft. The ethylbenzene obtained by this distillation is forwarded to the second plant where it is dehydrogenated. The benzene, diethylbenzene, and polyethylbenzenes are recycled in the first plant for further

(*Continued on page* 94)

Granule blending assures uniformity of polystyrene powder

Continuous Injection Molding and Extruding

New Machine Performs Both Operations; Cuts Production Time with High-Pressure Worm Feed



Walter P. Cousino, inventor of the machine, removes a mat of 144 synthetic rubber link bushings as operator feeds a roll of rubber into the injection head above

THE continuous injection molding and extrusion of plastic and rubber materials—long-sought objective of the industry—is reported by Chrysler Corp. to have been achieved with a new machine which in performing both operations has made it possible to produce objects of extraordinary size and complex shapes and tubing of practically unlimited length.

Among the products injection-molded in one continuous operation by the machine is an 8-lb thermosetting battery case, which has an interior of complex design. This was accomplished in less than 5 min using 128 oz of plastic material, as compared with the closest maximum of 36 oz achieved by another injection molding machine.

Varied Operations

Other items manufactured advantageously and easily on the new machine include extruded thermosetting plastic paper-filled tubes of 1½" ID and with ¼" walls, produced in experiments with cases for incendiary bombs. A similar item was produced without the paper filler.

Extruded thermosetting plastic paper-filled tubes of 2⅛" ID with ¼" walls were successfully turned out in the course of experiments for the manufacture of rocket-launching tubes. Also produced in the same experiments were similar tubes without the paper filler, but with 5" ID and ¼" walls.

In searching for a substitute for wooden panels, the machine produced a thermosetting plastic paper-filled bar. It turned out a thermosetting plastic paper-filled butt and nose for the tubes (mentioned above) used for incendiary bomb cases.

A mat composed of 144 synthetic rubber link bushings for shock absorbers is produced on the machine licensed to Monroe Auto Equipment Co., Monroe, Mich. A link of rubber is fed into the injection head, and, free of flash or waste material, the mat of bushings comes from the machine in 3 min. This machine can also produce a special type of rubber gasket 5" in diameter and ¼" thick used in aircraft engines, and a synthetic rubber seal used in place of a gasket in sealing metal pipelines, and thermoplastic and natural rubber carburetor bowls. The new machine permits manufacturers to inject material in a continuous stream as long as there is mold area to be filled. Different dies can be used for different sizes of products with the same continuous injection head.

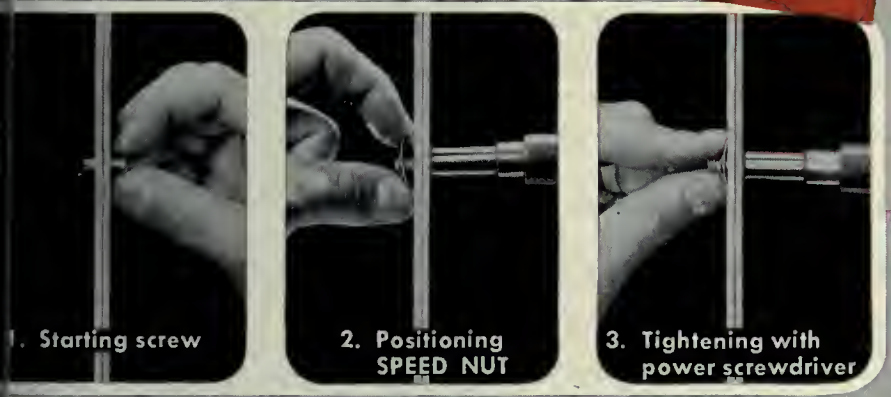
Construction

The continuous injector consists of a hopper from which the raw material is fed into a heating cylinder where it is churned to achieve an even mixture. Then worm screw pressures up to 22,000 psi force the material through a nozzle clamped to an opening where it meets the die plates, which are moved by hydraulic pressure. When all corners of the mold are filled, back-pressure

(*Continued on page* 108)

Which is Better?

THE OLD WAY WITH 5 HAND OPERATIONS



OR THE SPEED NUT WAY WITH ONLY 3 OPERATIONS

And a SPEED NUT is a self-locking nut, too, that weighs less, stops vibration loosening and cuts assembly costs 40-50% . . .

The SPEED NUT method requires only 3 hand operations as shown in photos above. And only 2 parts are needed instead of 3. Why go through 5 hand operations when only 3 are necessary? Why handle 3 parts when only 2 are required? For an eye opener on the economies of the SPEED NUT system just multiply this 40% motion-saving by the millions of fasteners you use per month. Then add to that the saving by eliminating 1/3 of the parts. Your figures will amaze you. The winning products in postwar competition will be those that are assembled faster and protected against loosening from vibration. Billions of SPEED NUTS were used before the war and on war products, too. More billions will be used on postwar products. Over 2,000 shapes and sizes. Engineers who move up faster are those who know how to make assembly lines move faster. Write for literature.

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FASTEST THINGS IN FASTENINGS

Speed Nuts* [PATENTED]

*Trademark Reg. U. S. Patent Office

CAPITAL Report

By Arnold Kruckman

PLASTICS' Washington Correspondent

THE most solid and sober elements among the responsible officials in Washington think decidedly the shift to peacetime existence will *not* be accompanied by widespread unemployment and industrial paralysis. They anticipate some sharp very local production logjams with strictly local unemployment, but they think there will be relatively few of these, and that none will last long, not long enough even to have much effect upon the sweeping rush to supply what we need to fill the vacuum created by the war, and to fill the void of almost incomprehensible destruction in Europe and in Asia.

There are now under way preparations to produce 1,000,000 telephone sets for civilian use; and a relatively large number of alarm clocks. There has been considerable momentum in production of artificial limbs and other orthopedic specialities. Strippings and other rejects of vinyl chloride resins, with consent of WPB, shortly are expected to start a substantial production of plastic soles. Back in June, 750,000 yards of nylon cloth found unsuitable for parachutes and other military uses was released for civilian use as fabric.

The lack of plasticizers is the chief obstacle to civilian production, and is regarded as the main interference with quick reconversion.

Government Interest in Plastics

Government officials fear that sensationalism and the attempt to glamorize plastics may seriously harm the business in its operations and in the security market. For this reason, they exercise considerable caution in discussing plastics with non-plastics persons.

The Bureau of Foreign and Domestic Commerce is keenly interested in the subject of plastics, and in the very near future will publish an exhaustive report on the Brazilian plastics industry. Brazil is one of the most active plastics countries of South America, and it is reported the Foreign Economic Administration is now trying to persuade WPB's Chemicals Bureau to permit the exportation of plastics molding machinery, injection and extrusion, to Brazil.

The growing interest in plastics within Government itself is indicated by the request for a report on the subject by the Ways and Means Committee of the House from the U. S. Tariff Commission. The report is understood be in the course of preparation by Dr. B. F. Bergen of the Chemical Division, which is headed by Dr. James H. Hibben. Dr. Hibben recently published a Summary Report on the Production and Sales of Synthetic Resins during 1943. This is the first report of the kind during the war period. It does not include any products which are in the least debatable. As is well known many products are frequently included which are occasionally questioned, although generically they might be justified as coming within the classification of synthetic resins. With these strict limitations the U. S. Tariff Commission report indicates the total of synthetic resins for 1942 amounted to 297,000,000 pounds, while in 1943 the total was 379,000,000 pounds. From another source comes the informal information that Government records appear to show that all types of plastics materials produced in 1943, including 2,000,000 pounds of casein and soyabean products, also lignin, wood wastes, powders, etc., total an aggregate of 760,000,000 pounds, of which approximately one-third went into coatings.

More Business

After a meeting with more than 100 weavers, throwsters and finishers of nylon, in the offices of the National Federation of Textiles at New York, the War Department announced it is procuring 28,000,000 square yards of nylon before January, a twill to be used as material for light-weight ponchos; woven netting for insect bars, head nets and jungle hammocks; taffeta for special items such as sleeping bags. The new purchases are in addition to 15,000,000 yards in process of production.

The Quartermaster General's Office, and the Brooklyn Polytechnic Institute together with the National Research Council are seeking to find a way to make plastic fabrics stronger and lighter. Phthalate plasticizers being critically short, the investigators are trying to find formulae for new plasticizers. The purpose is to use the materials for raincoats, ponchos, mountain tents, shelter tents, ground sheets, parkas, trousers, jungle hammocks, waterproof bags, and gas-protective items. Plastic films also are being developed for use as protective coverings for food and other supplies which must be protected from moisture in shipment. From the National Farm Chemurgic Council word has come to Washington that the National Dairy Products Corporation has produced a textile from casein of skim milk that is soft, fleecy, with many qualities of natural animal fibers. It is called Aralac. It has been made up in soft woolly coatings; harder finished worsteds; coverts; flannels, gabardines, serges, challis, and light linens; also in pile fabrics. It is reported millions of pairs of half hose and anklets have been knitted of Aralac. It is moisture absorbent, has made many good sweaters, warm blankets, and has been used in making wigs. It is reported to drape well, and is good material for tailoring. From 50,000,000 to 60,000,000 pounds skimmed milk is available to produce the material each year. The casein is ground into powder, mixed with several chemicals, and extruded through spinnerets. The result is a rope-like tape called tow, which after several chemical treatments is dried and cut into staple lengths, and baled in 500 pound lots. It is then ready for the yarn spinning mill. It may be blended with wool, rayon, cotton, or any combination, up to 50%. . . . Department of Commerce has a report that an Institute of Plastics has been established in New Zealand to develop the industry in the antipodes.

END

and they all tell the story of

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the Extruded Plastic Tubing with "no end of" end uses

Giant bombers, card-index files, sunstills, plumbing fixtures, black lights, musical instruments, freezing coils, floating lanterns, fountain pens . . .

They, and hundreds of other unrelated products are proving the versatility and practicability of TULOX Extruded Plastic Tubing.

TULOX is manufactured by our *exclusive* process from many different base resins, in simple or complicated cross-sections and to *micromatic* tolerances. TULOX can be in color or colorless—transparent, translucent or opaque.

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TULOX Tubing is not "just another plastic tubing." It is a quality product with unusually interesting possibilities for today and post war.

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What is *Good design* in Molded Plastics?

GOOD DESIGN in molded plastics is design that utilizes the characteristics and properties of plastic materials to the best advantage. Naturally, that requires an intimate knowledge of materials, methods, and techniques.

An excellent example of what we mean is the hinged cover and bezel of the "Megger" Insulation Tester (shown above) molded by CMPC for James G. Biddle Company of Philadelphia. Instead of resorting to drilling and inserting hinge pins, CMPC designers and engineers found a better way. Bezel and hinged lid are produced in only two parts without the use of metal. The flexible bezel (molded of cellulose acetate butyrate) can be bent slightly for easy assembly. When attached to the case it is held rigid forming a substantial hinge.

Simple, isn't it? No magic . . . no hocus-pocus. Just good common sense coupled with the "know-how" that comes only with practical experience in plastic molding.

If you are planning a molded plastic part, why not call in a CMPC Development Engineer who can apply this "know-how" to your own problems? His knowledge and experience as well as that of our entire organization are at your disposal, together with the resources of the largest, best equipped custom molding plant in the Middle West. Write us today. Your request incurs no obligation.

Here's How a CMPC Development Engineer Can Serve You . . . NOW

- By analyzing your products to determine what parts, if any, can be advantageously molded of plastics.
- By helping you in the selection of the best material or materials for your job.
- By putting at your disposal practical experience with the latest war-time developments in plastic molding materials and methods.
- By furnishing preliminary cost estimates to help you in choosing the most economical production methods.
- By suggesting design for most effective and economical utilization of plastics.
- By making laboratory tests to determine suitability of materials for special applications.
- By building experimental molds for sampling and tests.

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WHAT'S *New* IN PLASTICS

Reduces Effects of Solvents on Cellulose

Tennessee Eastman Corp.
Kingsport, Tenn.

A method whereby the usefulness of cellulose ester plastics, such as its *Tenite I* (cellulose acetate) and *Tenite II* (cellulose acetate butyrate), may be increased.

It has found that, by producing *surface hydrolysis* (the reconversion of the surface composition back toward cellulose) of the molded plastic, the effects of exposure to certain organic solvents are largely overcome, and cellulose plastic articles may be immunized against the action of solvents such as are encountered in the Army's newly developed insect repellents.

Contact with some solvents or solvent plasticizers causes cellulose ester plastics to become tacky, to swell, or distort. The more active solvents, such as acetone or acetic acid, will finally dissolve the base material upon continued contact.

Surface hydrolysis is obtained by dipping the cellulose ester plastic in a solution containing an active hydrolyzing agent, such as sodium hydroxide, and a softening or penetrating agent, such as methanol. The hydrolyzed layer produced should be approximately 0.002 to 0.003". After a thorough rinsing in water, the hydrolyzed samples are dried, preferably in a 150° F oven.

This form of solvent resistance makes possible cleansing operations on articles molded from cellulose ester plastics which have not hitherto been considered practical. Surface hydrolysis does not give immunization against continued exposure to very active solvents, such as acetone and the Cellosolves.

The physical properties of the dipped plastics are apparently unchanged by the treatment. Tests for flow temperature, elongation, tensile strength, moisture absorption, and leaching, run on dipped and undipped samples, showed no difference between the two lots, indicating that the toughness of the plastic is unimpaired by surface hydrolysis. .....(100)

"Plexiglas" Camera-Range Finder

Rohm & Haas Co.
Philadelphia, Pa.

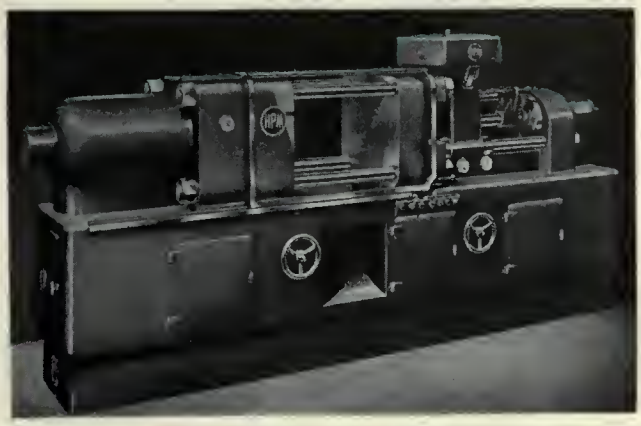
Recent application of this transparent plastic to a use demanding strict accuracy. The finder guides reconnaisance photographers in gaging the field their lenses cover from various altitudes.

The finder is molded in a single operation, even to the mounting holes and undercut flange, but is opaqued where required. The acrylic is as transparent as optical glass but less than half as heavy, flexible and difficult to shatter; can be machined and threaded like any soft metal. .....(101)

To simplify for our readers the task of obtaining detailed information regarding the new products, processes and trade literature described herein, ***PLASTICS*** offers the prepaid postcard inserted here.

In rapidly-moving times such as these, keeping up with every latest development in one's field is a "must." War's insatiable demand for swifter production, and the competitive drive toward lower manufacturing costs require that all avenues leading to a solution of these problems be explored thoroughly.

Each item in this section is keyed with a number, which should be entered on the postcard to facilitate identifying the exact product, process or publication about which information is desired.



Injection Molding Machine

Hydraulic Press Manufacturing Co.
Mount Gilead, O.

Capable of injection-molding thermoplastic materials up to a capacity of 16 oz.

The machine (above) has a double-acting ram as part of the hydraulic mold clamp, also a movable die head—a solid steel forging, arranged so that it can be moved forward hydraulically to permit automatic retraction of the mold from the nozzle tip, thus breaking the sprue. To allow for easy access to the heating chamber, the die head can be moved forward hydraulically until the chamber is clear, thus permitting the operator to inject material into the atmosphere without entering mold. .....(102)

Determines Relative Porosities

B. F. Goodrich Co.
Akron, O.

An apparatus which can determine the relative porosities of materials by the degree of vacuum in a chamber.

The device provides a mechanism which draws air or gasses through the material, indicating the rate of flow. The apparatus was originally designed for testing the porosity of sponge rubbers, but it has other applications. Small and compact, the unit can be easily lifted and transported with one hand...(103)

Plug Gage Collets of "Tenite"

Turner Gauge Grinding Co.
Ferndale, Mich.

Black and red collets, tapered and slotted to fit standard plug gage handles to increase the life of the gaging surfaces (photo below).

Use of *Tenite* prevents scratching or burring of the surfaces and permits most of the gage's length to be used. As the "go" and "no-go" ends are worn beyond allowed tolerances, they are simply cut off and an unused end is ready for gaging. The color red permits quick identification of the "no-go" parts.

Notching the shoulder of the collet for an end wrench facilitates resetting. A thin slot the length of the collet takes up slack in the locked position. Two shallow flat surfaces on the taper make possible dimensional adjustment under pressure. The gauge handles are also made of *Tenite*.....(104)

Metal-Plated Plastics for Commutators

Metaplast Co.
New York, N. Y.

Intricately-designed units can be produced by using metal plating over thermoplastic materials. Grooves and depressions are molded or machined wherever contact surfaces are desired. These are then built up flush with the non-conductive surface by *Metaplating* silver or any other desired metal. The surface of the commutator is then ground mirror-smooth. This makes the commutator into a conductor-non-conductor unit which can be produced in any shape desired with any commutating contour, at considerable time and labor saving (photo above).

A flat unit having 83 conducting segments 0.005" wide and separators 0.012" wide has hitherto been made by stacking alternately small sheets of silver and *Bakelite* on a threaded brass shaft insulated with a *Bakelite* bushing. The whole assembly had to be clamped together with a nut on each end of the shaft, with the clamping pressure often causing the plastic separators to cold flow above the commutating surface. Each segment had to be soldered to one of two circuits, making a total of 83 soldered joints.

The new method involves molding of the commutator with 0.005" grooves for the conducting segments and two wide grooves for the connections. After *Metaplating* and grinding smooth, the commutator is complete with connections and without necessity for soldering. The molded part varies only 0.005" in length, thus eliminating separate calibration charts for each instrument. Clamping is eliminated, as are also the gaps between conductor and insulator. .....(105)

"Saran" Tubing in Fumigation

Dow Chemical Co.
Midland, Mich.

Use of translucent *Saran* tubing in fumigation of boxcars to prevent the development of food infestation. The applicator is manufactured by the Arrow Products Co. of Carlstadt, N. J. The method allows fumigation from outside the car, simply by placing 1 lb cans of methyl bromide in the applicator, which punctures the can, allowing the gas to escape.

This permits overnight fumigation, a time-saving factor of importance when vast quantities of vital foodstuffs must be protected against infestation.

The end of the tubing is plugged with an ordinary bolt with two small holes drilled on the sides of the tubing near the plug, which allows the gas to escape to either end of the car above the load. This apparatus may also be used in vault fumigation. *Saran* tubing has proved to be highly adaptable to this type of fumigation because of its chemical resistance and its flexibility, the latter simplifying installation.....(106)

Plastic Identification Card

Photodenticator
Chicago, Ill.

Provides protection for identification cards, photographs and documents in a moisture-tight fire-resistant coating of transparent material which projects over the edge of the card about 1/8". The edge is sealed with a moisture-tight joint (photo left).

Thickness of the card after being enclosed in the plastic is from 0.01 to 0.02" The material is sealed under 5000 psi at 235° F to completely enclose the item being protected. In the case of identification cards, to make the card non-counterfeitable, a second photograph of the individual may be sensitized on to the enclosed card. .....(107)

Versatile Tape Insulator

Irvington Varnish & Insulator Co.
Irvington, N. J.

A plastic tape with diverse applications in the electrical field, including insulating wires, cables and electrical equipment; splicing cables; and protecting wiring, piping and materials exposed to corrosive fumes, oil, grease, acids, alkalis or moisture.

Flexible and elastic, *Fibron* tape is manufactured from *Vinylite* resin, is heat-sealing, flame-resistant, and high in dielectric and mechanical strength. .....(108)

Properties of "Fibron" Tape

Tensile strength (psi)	1700
Dielectric strength (0.012"—v/mil)	1000
Low temperature flexibility (°C)	—40
Elongation (%)	250-400
Power factor @ 30° C (%):	
60 cycles	6.5
1 kilocycle	6.2
Dielectric constant @ 30° C:	
60 cycles	7.6
1 kilocycle	6.9
Bonding temperature (°C)	approximately 150

"Plaskon" Magnifying Unit

Boyer-Campbell Co.
Detroit, Mich.

Plaskon urea-formaldehyde molding compound is utilized in a combination magnifying lens and lamp, termed the *Super Sight*, a compact unit combining magnification and properly-directed light to meet the exacting requirements of doctors, surgeons, dentists and dermatologists. It is also being used

in large numbers by industrial personnel doing inspection, fine assembly and high-precision work (photo above).

The frame, including the reflector of the lamp, is molded in one piece of *Plaskon*, an electrical insulator. The *Plaskon*, which makes the frame attractive, light in weight, easy to clean and shatter-resistant, is inert, and resists the effects of water, oils, common organic solvents, and does not discolor, tarnish or corrode. Mounted on stand or connected to clamp-on device, the *Plaskon* molded color unit can be moved to any position desired with finger-tip control. .....(109)

Portable Dust Collector

Dust Filter Co.
Chicago, Ill.

Removes dangerous and obnoxious dusts arising from industrial operations, first by the centrifugal separation of the dust from the air, and second, by impinging it on the filter surface, maintaining a constant static air suction of more than 4" H_2O at a velocity of over 500 linear fpm. Weighing from 75 to 200 lb, the units range in height from 30 to 51". The filter consists of two corrugated layers of wire mesh covered with 60-mesh filter cloth. Filtered air is discharged through a sound-muffler.

Removal of dust is essential, the firm points out, not only to protect personnel, but also to keep abrasive or corrosive dusts from valuable equipment. .....(110)

Improved Latex Insulation

J. S. Rubber Co.
New York, N. Y.

Nubun, a new synthetic rubber latex insulation for power, lighting and communication cable, which will permit the design of new types of wire and cable with improved electrical and physical characteristics.

Qualities include flexibility, impermeability to water, laminated construction; perfect centering of the conductor to produce an insulated wire of maximum conductivity and minimum diameter; exceptional homogeneity following vulcanization; high dielectric strength and insulation resistance; low specific conductive capacity; good aging qualities because of the presence of special anti-oxidants; and resistant to severe wear because of the latex process in which the rubber particles are not distorted or broken down by milling. *Nubun* is made from a special modification of Buna S synthetic rubber.....(111)

Properties of "Nubun"

Physical Tests	Before Aging	After 96-Hr Aging in Oxygen Bomb
Tensile strength (psi)	2500	2000
Elongation (% in in.)	2-13	2-11
Set (in)	5/16	——
Electrical Tests		
Voltage breakdown after submersion in water at room temperature (v/mil)	650	
Insulation resistance constant K after submersion in water at room temperature	54,000	
Specific inductive capacity at 70° C:		
After 1 day in water	3.0	
After 3 days in water	3.2	

Self-Flaring Plastic Tube Coupling

Packless Metal Products Corp.
New Rochelle, N. Y.

Requires no flaring tools, since the flare is formed as the members of the coupling are screwed together in one simple operation, thus assuring uniform walled flare, without thinning toward the end to weaken the tube. The plastic tubing is not pre-heated.

Construction provides a union effect to eliminate twisting and distortion of the tubing in installation, as well as split ends. Only simple tools are needed. Couplings may be reused indefinitely. .....(112)

Laminated Phenolic Gun Plate

Penn Fibre & Specialty Co.
Philadelphia, Pa.

Use of canvas-base laminated phenolic sheets in the Colt official police special .38 cal type gun butt plate. The sheets were made by Taylor Fibre Co., Norristown, Pa.

This material was chosen because of its strength and extremely light weight, the latter being of considerable importance in the item produced so that it does not overbalance the gun. The material does not crack easily and is not affected by weather. According to the manufacturer, it often outlasts the gun. .....(113)

Protective Hand Cream

E. I. du Pont de Nemours & Co.
Wilmington, Del.

A water-resisting hand protective cream for workers whose jobs bring them into contact with water-soluble cutting oils, dilute acids, alkalies and other water-chemical mixtures.

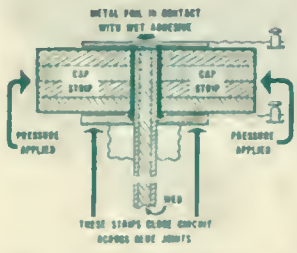
Known as *Pro-Tek No. 2*, it is intended for operations where water is present and the standard water-soluble *Pro-Tek* unsuitable. By protecting against a number of chemicals, it eliminates the necessity of separate creams for each particular need.

The new cream, applied to the hands and arms before starting work, forms a flexible, slightly greasy film which acts like an invisible glove. One application lasts from 3 to 4 hr and may be removed by using an industrial hand cleanser or washing in hot water with a mild soap. .....(114)

Literature Review

Story of "Duramold"

Duramold Division
Fairchild Engine and Airplane Corp.
New York, N. Y.



Describes the *Duramold* process for fabricating non-strategic materials into aircraft structures through the use of a plastic combining moldability with stiffness and light weight.

Duramold, it is pointed out, makes possible the elimination of rivets and bolts, permits the use of thin section for monocoque construction, and has high resistance to climatic conditions. It is a process by which any light, fibrous material, such as wood, paper, fabric and glass fibre, is combined with plastic adhesives and molded under controlled heat and pressure to provide a structure of precise dimensions. *Duramold*, according to the bulletin, differs from other bag molding processes in requiring higher pressures and more exact controls.

The sketch above shows a cross-section of the joint when bonding a cap strip to a bulkhead web with a small high-frequency generator and jig, which is equipped with pneumatic pads to maintain "fluid" pressure during the operation. Also shown is the method of shooting current directly through the wet glue lines, scarcely heating the wood at all.....(115)

Oil-Resistant Lignin Board

Wales-Strippit Corp.
North Tonawanda, N. Y.

Bulletin No. 6, describing *Walesite*, a laminated lig plastic.

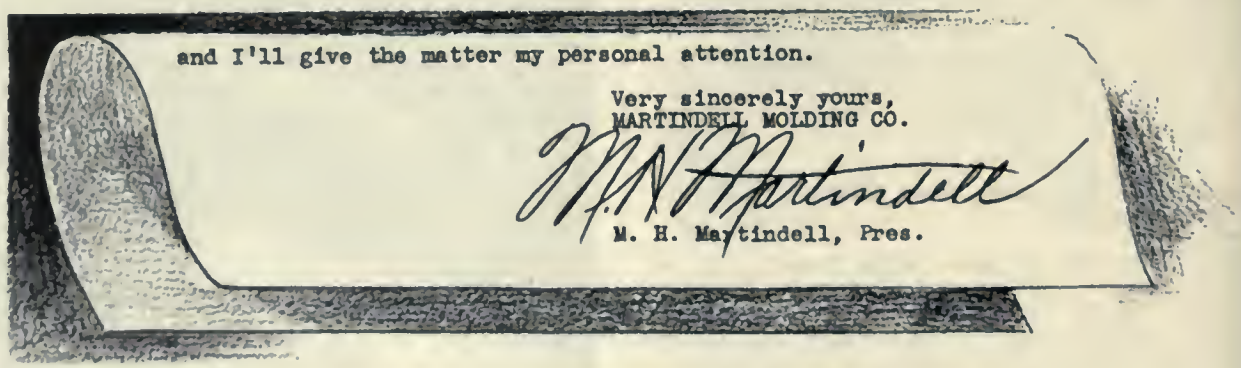
The material is strong and light, uniformly dense, resista to water, oil, grease and dilute acids, and has high mechan ical strength. Although half the weight of aluminum and le than one-fifth the weight of steel, it is easily adaptable to mo fabricating purposes, and contains no critical materials.

It can be sawed, turned, drilled, tapped, threaded and mill using metal working tools. The best results in circular sawi are obtained with tungsten carbide-tipped saws having 4 teeth, a 14" diameter and a 10° top bevel on the teet operated at 3600 rpm. Band-sawing should be done at 600 fp with a saw having 3½ to 6 teeth per in. .....(116

"Walesite"—Physical Properties*

Specific gravity	1.
Tensile strength (psi)	7500-12,00
Compressive strength (psi)	25,000-35,00
Flexural strength (psi)	
Edgewise	16,000-20,00
Flatwise	16,000-20,
Impact strength (Cherpy or Izod—ft-lb per in of notch)	0.6-0.
Surface hardness	
Rockwell M	10
Brinell	4
Maximum heat resistance	
°C	8
°F	17
Moisture absorption (24 hr immersion)	
Thickness (In)	%
1/16	3.5-4.
1/8	3.0-4.
1/4	1.
1/2	0.

*Tests made in accordance with ASTM methods.



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ENGINEERING
News Letter

By **LEWIS WINNER**
Market Research Engineer

Applications . . . Methods . . . Materials

The accelerated development of high-frequency equipment has prompted the processing of many useful plastics such as polyethylene, polybutene and polystyrene. And now another high frequency plastic has joined this family. It is a styrene type and made by General Electric. Known as *Textolite* 1421, it has a dielectric constant of 2.4 to 2.5 at 300 megacycles. Its power factor at 300 megacycles is 0.0006 to 0.0009. Without load it will retain its form up to 200° C, being rubber-like only at these temperatures. On cooling it assumes its hard form again. The material is supplied in rods and sheets. In rods the diameters vary from ¼" to 2¼". The present maximum size of plates available are 12" × 12". The maximum length of the rod stocks is 10".

Physical Properties of "Textolite" 1421

Color	Pale yellow to water-white
Machinability	Good, similar to brass
Specific gravity	1.04-1.06
Tensile strength (ASTM D-48-37—psi)	10,500-12,500
Modulus of elasticity (in tension at 78° F)	1.07×10^6
Flexural strength (psi)	10,000-11,500
Impact strength (Izod ft-lb per in at 78° F)	0.36-0.52
Impact strength (Charpy ft-lb per in at 78° F)	2.5-4.5
Rockwell hardness (⅛" ball 60 kg load—H scale)	35-60
Heat distortion	75-80° C
Thermal expansion	8.25×10^{-5} °C
Thermal conductivity (cal/sec/cm/°C)	0.00382
Specific heat (cal per grm per °C)	0.347
Water absorption (%, 24 hr)	0.05%
Solvent resistance	Generally insoluble in most solvents but swells in aromatic hydrocarbons.

Plate stock having a designated thickness of 0.1" has an average weight per sq ft of 0.55 lb. Stock with ½" thickness has an average weight per sq ft of 3.03 lb.

The Charpy and Izod methods have become standard practice in judging the impact resistance of plastic materials. Charpy is the simple beam, while Izod is the cantilever beam. In these processes the energy absorbed from a pendulum in breaking a standard specimen is measured. The American Standards Association has just completed work on an analysis of methods of testing for impact resistance of plastics. Committee D-9 on Electrical Insulating Materials of the ASTM developed the methods described. The analysis is known as ASTM D-48-43T; ASA C59.1-1944.

Lacing Cord

The tropics have always been a challenge to the plastics engineer, particularly those engaged in field material development. Many types of materials to resist tropical insects, termites and humidity have accordingly been developed. Even waxed twine has been replaced by a lacing cord made of vinylite. The tensile strength of this cord is 2400 psi, while its elongation at break it 250%. Low temperature flex test is —20° C, while its maximum operating temperature is 70° C. Since this lacing cord is used in telephone and electronic applications, its electrical properties were also improved. At 1000 cycles, its power factor is 0.126 (at 30° C). And at the same temperature and frequency, its dielectric constant is 7.4. At 25° C, its dielectric strength is 0.025 v per mil at 900 v.

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association activities

ACS Convention Yields Significant Plastics News

THE 108TH meeting of the American Chemical Society, held recently in New York City, brought forth a host of papers packed with discoveries and data of vital import to the plastics industry.

One significant paper dwelt upon the vast store of potentially useful raw material available to the industry in the nation's sawdust waste. Delivered by Dr. Donald F. Othmer, Dr. Robert S. Aries and Dr. Raphael Katzen, Polytechnic Institute, Brooklyn, the document pointed out that *enough plastics to produce the plastic parts for 4,000,000 automobiles, 1,250,000 telephone sets and 10,000,000 door knobs . . . could be obtained from as little as 10% of the readily available sawdust waste in the United States through a new process.*

The method involves the continuous chemical adding of water to wood, and yields, from 1 ton of sawdust, more than 1000 lb of a high-grade ingredient for plastics, as well as valuable chemicals as by-products, including 120 lb of acetic acid, 60 lb of furfural and 500 lb of sugar, which could be converted into hundreds of pounds of alcohol.

Left, Dr. Horace E. Riley, Bakelite Corp., served as general chairman. Right, Dr. Thomas Midgley, Jr., president of the American Chemical Society

Recovery of the chemicals is done by a special treatment of the waste liquors under pressure, which breaks down their molecular structure. Then other chemicals are added to absorb the valuable constituent and eliminate the water and impurities by washing. Liquids used for washing are separated by distillation and may be re-used indefinitely.

In addition to the plastics produced from only 10% of the nation's sawdust waste, the acetic acid obtained simultaneously would be enough to produce rayon for 130,000,000 pairs of stockings by combining it with cellulose, another wood product. Wood sugars, another by-product of the sawdust hydrolysis, could be fermented into enough industrial alcohol to release for 2 months the facilities of beverage alcohol producers for manufacture of whiskey and other liquors, Dr. Othmer stated.

Purer Butadiene

A technique for producing purer butadiene was described in papers presented by Dr. Othmer and Drs. Walter Koszalka, William S. Bergen, Nathan Schlechter and Paul F. Bruins of the Polytechnic Institute. The process is currently being considered as an additional method to produce more rubber for the war program. In addition to increasing the purity of butadiene, the method requires much less equipment, with consequent saving in production costs.

Reducing Brittleness of Cellulosics

Brittleness and crazing caused by ultraviolet radiation on cellulose ester plastics can be inhibited by adding a suitable organic compound such as salol (phenyl salicylate), according to an address delivered by L. W. A. Meyer and W. M. Gearhart of Tennessee Eastman Corp.

This compound, they pointed out, absorbs the radiation and emits the resultant energy in a form not harmful to the surrounding material. The discovery has been applied to improvement of bayonet scabbards, truck and jeep steering wheels and many small arms components. Post-war possibilities are numerous.

Plastics from "Butter"

Potentially valuable plastics raw materials can be produced by condensing biacetyl (the essential ingredient of butter) with ketene to give unsaturated intermediate materials which may be polymerized to give plastic-like products, according to a paper given by J. A. Spence and E. F. Degering of Purdue University.

Biacetyl, which gives butter its characteristic taste and smell, possesses the chemical structure of a diketone. Ketones can be condensed with ketene to yield unsaturated esters of the vinyl type. From acetone and ketene is derived an analog of methyl methacrylate. The compounds obtained in the course of this process promise wide use as monomers in developing *a new series of polymers, which may be used alone or with other materials to form new synthetics.*

Azeotropic Copolymers

Prediction of the existence of "azeotropic" copolymers, having a definite composition and a more or less fixed arrangement of monomer units, was made by Dr. Frederick T. Wall, University of Illinois. In these compounds, the monomer mixture and copolymer can have the same composition, thus minimizing certain manufacturing problems.

Plasticizers for Elastomers

K. K. Fligor and J. K. Sumner, Resinous Products & Chemical Co., announced that certain new resinous plasticizers derived from sebacic acid have been found to impart certain unique and valuable properties to synthetic elastomers, particularly polyvinyl chloride-acetate copolymer and butadiene-acrylonitrile rubbers. The plasticizers are marked by outstanding permanence; oil, water, solvent and gasoline resistance; heat stability; and low flammability.

Thermoplastic Cellulose Laminates

Low-pressure thermoplastic laminates with exceptional toughness, which can be heated and drawn into complex shapes with inexpensive equipment and can be fabricated quickly, were disclosed by C. W. Eurenius, R. H. Hecht, William Koch and H. C. Malpass of Hercules Powder Co. Individual parts of these materials can be joined with heat or solvent sealing.

The research involved using cellulose acetate and ethyl cellulose binders with cloth and paper fillers. With proper selection of materials, qualities such as low-temperature flexibility, low or high modulus and excellent dielectrical properties are obtainable. The pressure combinations show better tear resistance than the plastics from which they are made, and color range is unlimited.

Future of Polythene

Possible application of polythene to such uses as protecting metal surfaces from corrosion through coatings applied by flame spraying the powdered material, was indicated by F. C. Hahn, M. L. Macht and D. A. Fletcher of duPont. Certain flame-sprayed compositions show outstanding adhesion to metals and protect them from rust formation.

Polythene has unusual water resistance, and the desirable electrical properties characteristic of hydrocarbons, such as extremely low power factor and low dielectric constant, along with high restivity and dielectric strength.

It has widespread prospective application in the form of insulating knobs and buttons for various electrical equipment; also for gasketing, containers for corrosive materials, coating of cloth, paper and wood, and impregnation of paper containers for milk and other liquids.

Because of its relatively low density (around 0.92 at 25° C) its covering power per pound is greater than that of other plastics. For this reason, and because of its low moisture-permeability, polythene should have an extensive future in packaging, particularly of foods.

In coating polythene by flame-spraying, particles of finely-ground material pass through a flame and are either softened on the surface or are completely melted before they come in contact with the article being coated. These particles solidify and form continuous coatings.

Cuts Cost of Itaconic Acid

Reduction in the cost of itaconic acid, chemical useful in production of plastics, to about 50c a lb, was announced by Drs. Andrew J. Moyer, Lewis P. Lockwood and George E. Ward of the Northern Regional Laboratory of the Agricultural Research Administration.

This was made possible through a new manufacturing process, involving the fermentation of corn sugar with a mold, *Aspergillus terreus,* which is seeded on to the surface of a 20% sugar solution containing other necessary nutrients. It grows as a thick brown mat on the surface, which is kept in large shallow pans, and in 10-12 days produces 1 lb of recoverable acid for each 4 lb of sugar.

Urges Product Tagging

Detailed instructions regarding the proper handling of all plastic products should be given to the store buyer and to the ultimate consumer, Charles A. Peters, president, Plastic Club of the U. S. A., recently told a products design class of the Brooklyn Polytechnic Institute.

He stressed the importance of informing the consumer as to whether the product can be cleaned, polished and sterilized, how it should be packed for shipping, whether it will scratch or warp under certain conditions. This information, he said, should appear on the merchandise tag.

West-Coast Directory

A new directory listing all plastics molders, laminators, fabricators and consultants in the States of Washington, Oregon and California, has been published by the Pacific Coast section of the Society of the Plastics Industry.

The directory lists the complete membership of the Pacific Coast section, together with company affiliations and typical examples of the plastics products they produce, as well as individuals representing Eastern manufacturers of materials and machinery.

SPI Fall Conference Exhibit

As a prelude to its proposed National Plastics Exposition to be held after Victory, the SPI has announced the sponsoring of a non-commercial exhibit of plastics applications, which will take place in the Astor gallery of the Waldorf Astoria Hotel November 13 and 14.

Known as the Fall Conference Exhibit, the show will feature both peace-time and war developments. Exhibits should be sent immediately to the Ivel Corp., 211 West 61st Street, New York City, attention Mr. B. B. Green. All manufacturers, designers, architects, model makers, engineers, fabricators and others connected with the industry are invited to participate. No company names will appear on products, only the material used and end-application. Return of exhibits will be facilitated by tagging or marking. C. W. Marsellus, Universal Plastics Corp., 350 Fifth Avenue, New York City, is in charge of the exhibit.

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INDUSTRY HIGHLIGHTS

One thousand plywood freight cars will soon be built by Great Northern Railway Co. with material shipped to it by Cascades Plywood Corp. First of their kind to be built in this country, the 50-ton capacity cars are 4000 lb lighter than the average boxcars. Steel and lumber are combined in underframes and superstructures, while sheathings are made of 5/8" exterior waterproof type of Douglas fir plywood. Phenolic resin glue is used in making the plywood sheathing.

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A new Door Division has been established by U. S. Plywood Corp. to undertake development of a wide variety of doors. The firm has developed new designs and materials, and, with U. S.-Mengel Plywoods, Inc., has obtained exclusive sale of the Mengel patented *Airlok* core door.

•

Allyl alcohol is now being produced in commercial quantities by Carbide and Carbon Chemicals Corp. Most of the production of allyl alcohol up to now has been for high-priority uses. It has a molecule with an unsaturated linkage and a hydroxyl group and thus is an unusual raw material for chemical synthesis. It can be converted readily to acrolein, propionaldehyde, allyl halides, glycerol chlorhydrin, or glycerol. Resins formed from esters of allyl alcohol are characterized by great clarity, surface hardness, and ease of fabrication at low pressures, and may be used as casting or laminating resins. Allyl halides are used to introduce the allyl group into barbiturate sedatives and are also intermediates in the synthesis of the anesthetic, cyclopropane.

•

A saving of 60% in tooling costs, 50% in overall cost and 32% in weight has been accomplished by The Glenn L. Martin Co., Baltimore, through the development of a new laminated plastic for a loop antenna mounting plate used on the PBM *Mariner*. The material is made from a high tensile surface plastic and a resin-impregnated wood pulp core, and can be easily molded to irregular shapes and can provide special integral high-density areas for special stresses, as for attachment of fittings. Construction of the new plastic, which replaced phenolic fibre plate, begins with a core consisting of two sheets of resin-impregnated wood pulp. Ths is sandwiched between built-up plies of resin-impregnated facing paper in a box-like jig, and the whole assembly is stapled together to facilitate handling. It is placed in a kirksite die and covered with a flat pressure plate, and the die is placed between electrically-heated platens in a hydraulic press and heated to about 300° F.

USO Needs Scrap Materials

An appeal has been issued by the USO, National Blvd., Long Beach, N. Y., for scrap plastics, leather and fabrics to use in its arts and crafts projects, as part of the Navy Rehabilitation Program for returning servicemen.

PEOPLE

C. R. Terry, former executive assistant to the director of WPB's regional office in Cleveland, has been appointed sales manager of the new regional and branch office sales headquarters of The Hydraulic Press Manufacturing Co., Cleveland.

R. G. Dailey has become sales manager of the plastics (formerly thermoplastics) division of Standard Products Co., Detroit. For the past several years he has been plant engineer at Port Clinton, O., and St. Clair, Mich.

•

H. H. Bashore has become head of the rubber and plastics division, technical sales and service department of Precision Scientific Co., Chicago. He was formerly development engineer for the United States Asbestos division of Raybestos Manhattan, Manheim, Penn.; research director for American Abrasive Metals Co., Irvington, N. J.; development compounder for U. S. Rubber Co., Providence, R. I.; chief chemist for Whitehead Bros. Rubber Co., Trenton, N. J.; and assistant chief chemist at Vulcanized Rubber Co., Morrisville, Penn.

The Bashore resiliometer, puncture-tear tester, and hose flexing tester, are among his contributions to the rubber industry.

C. R. Terry

E. C. Maywald

L. F. Weyand

L. F. Weyand, general sales manager of the Minnesota Mining & Manufacturing Co.'s adhesive and coatings division since 1936, has been promoted to general manager, a new post entailing responsibility for all production, sales, research and laboratory activities of that division.

Elmer C. Maywald of Chicago, plastics consultant, has been appointed to represent Lester-Phoenix, Inc., of Cleveland in the Chicago territory. Mr. Maywald will handle this firm's complete line of plastic molding and die casting machinery, and will cover northern Illinois, western Michigan, northern Indiana, Iowa, Minnesota and Wisconsin.

Clark B. Kingery, assistant manager of Hercules Powder Co.'s Parlin, N. J., chemical plant, has been named manager of the Cellulose Products Department plant just established at Hopewell, Va. **W. Ernest Henry** will continue as manager of the chemical cotton plant at the same location.

C. B. Kingery

H. H. Bashore

W. E. Henry

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Seeing Through Contact Lenses

(*Continued from page 31*)

duces the "glassy" look inherent in the lens, since there is less reflection of light.

From an experimental curiosity 50 years ago, contact lenses have developed into an accepted and superior corrective device. They are especially in demand on the stage, screen, concert hall and pulpit by professional men and women who need clear vision but do not wish to have their appearance spoiled by unsightly spectacles. They are a boon to the yachtsman or sea captain on the bridge whose spectacles would be wet by flying spray; to swimmers who can wear the new device in the water; to engineers working in grease and steam, which necessitates frequent cleaning of glasses; and by nearsighted debs or dowagers.

When inserted into the lids, they are covered on the interior with a solution which fills the space between eye and lens and acts as a "liquid lens," overcoming any irregularity or astigmatism of the surface of the cornea. Spectacle lenses must be especially ground to correct the astigmatism. Besides, they cannot be placed closer than 12 mm in front of the cornea because of the eye-lashes. This limits their accuracy in the peripheral parts and also their field of vision. Contact lenses, being so much closer to the eyes, are optically superior, especially in the case of high powers.

Technicolor films have opened a new field for this device. When Orson Welles, performing in "Jane Eyre," wanted his eyes to look as if they had been scarred by fire, he wore contact lenses that had been purposely marred and discolored. Young eyes can be made to look old, an inflamed, drunken appearance can be created, or the color of the eyes can be changed at will.

Art as well as comfort and health is thus enriched by this development in plastics. That increasing numbers of persons wearing glasses will now turn to contact lenses is shown by the courses that have mushroomed all over the country, training operators in the fitting of the lenses. A professor of ophthalmology recently told a group of medical students that they would in time take the place of spectacle lenses completely for the correction of all eye-defects.

The all-plastic contact lens is molded from a variety of methyl methacrylate made in the United States which has a light transmission in the visible spectrum of 92%—as good or better than optical glass, due to the perfection of surface as well as to inherent clarity of the material. Its transparency is so nearly perfect that it has been found difficult to photograph. It has no selective absorption in the visible range, and transmits all colors of the spectrum fully. The material does not hinder the passage of polarized light. Transparency is retained almost indefinitely. After being exposed to sunlight and weathering for about 2 years, the material loses only 1% of its light transmission. The surface does not craze. Index of refraction is only slightly less than that of glass, varying from 1.488 to 1.489.

The only materials which affect methyl methacrylate are lacquer thinners, which have a solvent action, as do also the lower esters, aromatic hydrocarbons, phenols, aryl-halides, aliphatic acids and alkyl polyhalides, such as

Practically invisible, acrylic contact lenses make a real contribution to the wearer's appearance

chloroform and ethylene dichloride. It is not affected by any heat which the body can endure, and does not begin to soften until 157° F is reached. Molding is performed at temperatures considerably above 200° F.

Although one of the hardest transparent plastics, methyl methacrylate has a surface only as hard as copper, and is more easily scratched than glass. With careful handling, only hairline scratches—which have no optical effect when on the corneal surface—will develop. Tears fill up any scratches formed on the front surface, while the liquid "lens" behind eliminates the effect of any scratches which may occur on the concave surface.

The material is quite elastic and therefore more resistant to breakage than ordinary lens glass. While they can be broken by being stepped or hammered on, merely dropping them on a hard surface does not cause them to shatter.

Because of its large, well-arched corneal portion, the all-plastic lens tends to magnify the iris slightly, an effect which is often beautifying to the appearance of the person. The combination glass-plastic lens had the opposite effect.

The lens cannot break on the eye, and has been worn by football players, skiiers and under other hazardous circumstances. Its lightness tends to make the wearer less conscious of its presence than he is of glass lenses or spectacles. There is also less gravity drop, which, in the case of glass lenses produces a tendency to touch the cornea at the upper limbus either continually or as the lids are blinked.

The all-plastic contact lens may be worn comfortably by the average person from 4 to 10 hr per day, the usual period being 8 hr, although some wear them all day and others continuously for many days. END

Are Plastics Meeting Buyers' Needs?

(Continued from page 46)

In a recent survey, 70 distributors, or 14.5% of those queried, felt that plastics and/or textile composition soles will compete seriously with leather soles for dress shoes. For work shoes, 202 or 41.7% believed such soles will seriously compete with leather. In the sports shoe field, the new soles will compete, in the opinion of 259 or 53.5%. Plastics were in third place for shoe soles, in the opinion of the shoe distributors, many of whom regard plastics as a stiffer future competitor with rubber rather than leather.

In spite of objections and resistance, however, it is known that the A. S. Beck shoe stores alone retailed up to a half million pairs of shoes with plastics soles during the last 9 months.

Conclusion

Out of this welter of opinion, prejudice and preference one may read some pretty clear warnings: First, the trade must realize that no high-powered publicity campaign will, in the future, put across any plastics article which, when subjected to the test, doesn't stand up. Second, many merchandisers today constitute a well-informed group of plastics critics. They know what they want and they will sell only that in which they have confidence. It would, therefore, be of value to the trade to confer with buyers as often and as thoroughly as possible *before* launching on the production of new merchandise. In the final analysis, consumer acceptance of any goods will be pretty much determined by how it is presented to him through retail channels. END

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Phenolic Laminates in Aircraft

(Continued from page 51)

such as ammunition deflectors, deflector rings, ammunition hoppers, ammunition ejection chutes, and ammunition boxes for the various caliber shells. It has, to date, designed more than 30 different ammunition boxes and have shipped more than 50,000 of these boxes to the various aircraft plants manufacturing fighters and bombers. Being light in weight, the material is ideally suited to the application of guarding the various delicate instruments in the aircraft from hard blows. McQuay has made cable guards, valve guards and switch guards as well as other fairings to aid in streamlining planes.

The phenolics used are extremely hard and wear more slowly and uniformly than metals. They are not affected by acids or alkalis up to 10% concentration. Water, oil, gasoline or smudge exposure do not impair their qualities. They can absorb severe vibrations and shocks without

FORMICA

Average Properties

Laminated Phenolic Plate—Grade C

Property		Value
Tensile strength	(psi, thicknesses 1/16 to 1", average values)	9,500
Flexural strength (flatwise)		20,000
Compressive strength (flatwise)		38,000
Izod impact strength (ft-lb/in notch—width)		
Flatwise		3.2
Edgewise		2.0
Water absorption (average, sample @ 25° C. 3 × 1 × 1/16"—% by weight)		3

structural deterioration and are easier to handle and work than metal. They are readily adaptable to any construction or design, and are fire resistant. Their tensile strength averages 10,000 psi and flexural strength, 20,000 psi. Phenolic parts costs up to 50% less than metal due to savings in production man-hours. They will not absorb more than 4% moisture by weight.

Two main disadvantages of the plastic are: Products of certain complicated shapes cannot be produced from it since it will not form a radius of less than twice its own thickness, and at the present time cotton, its base, is hard to get.

These phenolics, which cost sixty-six cents per lb and weigh approximately 2/5 psf, are expected to have a wide variety of uses after the war as a possible substitute for tile because they do not chip; as table and desk tops because they are easy to keep clean and will withstand heat; and as automobile parts and luggage because they are light and will not scratch. Other possible uses include furniture, small boats, refrigerators, school and theater seats, airplane and automobile parts. END

Featured in the next issue of *plastics*—

PHENOLICS TOMORROW

Phenolics, which have been one of the most critical of all materials during wartime, are certain to rebound into the civilian picture with greater promise than ever before. In this article, E. F. Lougee, chairman of the Plastics Industries Technical Institute, highlights their values and limitations.

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Injection Molders

(*Continued from page 36*)

the heater and die, which is in contact with the heater nozzle. After the die cavity material has cooled enough to become substantially solid, the plunger is retracted, whereupon a fresh charge of material is fed into the feed cylinder by a hopper feed device for the next cycle. The dies are opened and the molded piece is removed.

This entire cycle, on all modern machines, can be performed automatically by means of timing devices built into the machine or manually by hand controls. Many jobs are run semi-automatically, the dies being closed with the manual control while the rest of the cycle is controlled by the timers until the dies again stop in the open position.

Value of Large Die Stroke

The Reed-Prentice 10H-22 oz mold may be studied as an example of design development: This was to be a large capacity machine and as such it was foreseen from past experience and from inquiries among various molders that die space and die opening stroke would have to be suitable to take dies for larger parts than anything then produced. The final specifications for these sizes were die plates 30 × 30″, maximum die height 20″, and die opening stroke 16″.

This large die stroke made it possible to produce exceptionally deep parts. The sprue or inlet into the cavity usually adds to the over-all height of such parts, so that a die opening of several inches greater than the height of the part is necessary in order to remove the piece from the mold. Moving parts of the mold itself also used up some of the available stroke. Incidentally, the first mold run on this machine was a storage battery case molded in clear polystyrene. This was a deep piece and had been difficult to produce on a machine having a short stroke.

Since many parts are thin or shallow and do not require the full die opening of the machine, some cycle time could be saved by shortening the stroke. By adding stop collars on the two large guide bars, the cross head is stopped short of its full stroke, and the die opening is thereby reduced by a like amount. These collars are easily added or removed, and the machine design is such that the movement of the automatic ejection mechanism remains the same whether they are present or not. The hydraulic oil pressure to the link cylinder is also cut off at the end of the die opening stroke in either case. This relieves the strain on the piston rod and cross head when the machine is short-stroked.

In connection with automatic ejection of pieces from the mold, it was found that difficulty was often experienced in ejecting pieces which were not symmetrical about the center line of the machine. Most machines provide means of automatic ejection either at the center of the die plate or at two points on its horizontal center line. Obviously, any die which requires greater ejecting force on one side of this center line is apt to give trouble because of the tendency of the ejector plate to tilt unless special compensating arrangements are built into the die. Provisions were therefore made in the design of this machine to provide additional ejection points at the extreme corners of the movable die plate. By this means, using connecting bars, parallel ejection is possible regardless of the location of the piece in the die.

In order to obtain the large die opening stroke as specified, it was necessary to develop an entirely new link mechanism. The arrangement used is a combination of the

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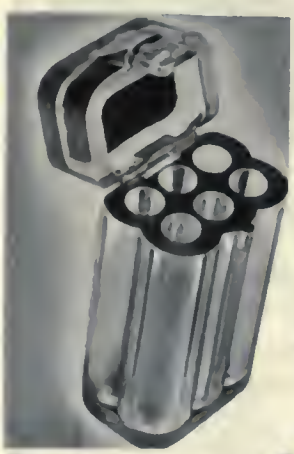

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ordinary toggle linkage and inclined plane or wedge abutments.

After the design was worked out, a small machine was built using the new type linkage in order to obtain some actual working data. In order to save time, the frame of the regular 8-oz machine having four tie bars was utilized. This construction did not permit the incorporation of the new linkage to the best advantage, but even so, tests proved it to have a somewhat higher locking pressure than the standard 8-oz model.

One of the advantages of this link arrangement, aside from the fact that a long stroke may be obtained, is that it can be designed with very large diameter link pins. As a result, bearing loads are relatively light, so that wear will be minimized. Breakage of link pins is expected to be eliminated.

Several years ago a large die casting machine was constructed in which heavy, torch-cut steel plates were used as strain members of the frame. The link mechanism was mounted adjustably within this frame and two large diameter screws were geared to a hand-operated crank to make die space adjustments.

Since a considerable amount of hard work was required in making major adjustments in the die space with the hand-operated arrangement, the new machine was provided with a geared-head electric motor to do this work. The set-up man merely has to hold down a push button to make adjustments. When the push button is released, a brake on the motor stops it instantly. Tests on the machine showed that it is easy to make adjustments of a few thousandths of an inch.

The use of two large adjusting screws not only keeps the die plates parallel at all times but puts all members in substantially direct compression or tension. The only member subjected to bending forces of any appreciable amount is the stationary die plate. Due to the span required to clear the heater, this is inevitable.

Since this machine was to be of large capacity, it was necessary to provide a heater in proportion. The internal design is similar to the heaters used in previous machines and represents years of gradual improvement and considerable experimental work. A design change was made, however, to eliminate breakage of cylinder liners which had caused some trouble in the smaller heaters. Heating elements are electric resistance bands of a new type. They are of triangular section and are fitted into grooves in the heater body. Front and rear sections of the heater are separately regulated by two pyrometer controllers.

Jet Molding

The machine was also designed for ready adaptation to jet molding, a patented process for injecting thermosetting material by means of a special heater and nozzle. The heater receives the material either from the regular hopper feed on the machine or by hand feeding into the feed cylinder if macerated, fabric-filled or other bulky materials are used. The heater is merely a cylinder having the same diameter bore as the feed cylinder and is only used to preheat the material to a temperature somewhat below its polymerization point.

The real heating to fully plasticize the material is done by the special nozzle, which is rapidly heated by passing a high amperage electric current through it at the moment of injection. A timing device shuts off this current, and the nozzle is cooled sufficiently to prevent curing of the material therein after die cavities have been filled. Water-cooled terminals on the nozzle speed the cooling. In this process, of course, the dies must be heated so that the moldings will be properly cured. Steam or electric elements are generally employed for this purpose. END

Resinoid-Bonded Abrasives

(*Continued from page 23*)

width. Such a wheel has actually more than 30,000 abrasive particles, each representing a cutting point, on its peripheral cutting surface. *At a rotative speed of 9500 ft or almost 2 miles per min, of which resinoid-bonded wheels are capable, this means that approximately 45,000,000 cutting points engage the work every minute!* Here is a high speed cutting tool in the fullest meaning of the term, capable of fashioning the hardest and toughest of modern alloy steels and other metals.

Some readers may wonder exactly what function the resinoid bond serves in a grinding wheel. Briefly, every abrasive wheel consists of two basic ingredients—the abrasive grains that do the cutting and the bonding material that holds these grains firmly in place while they perform their work. The bond is hardly less important than the abrasive inasmuch as the safe operating speed of any grinding wheel depends largely upon the strength of the bonding agent.

Since resinoid-bonded wheels can be operated safely at speeds as high as 9500 fpm, and the rate of stock removal increases in proportion to the increase in cutting speed, it is at once apparent, that the resinoid-bonded wheel has a high productive capacity on jobs for which it is especially adapted. Furthermore, unlike the rubber-bonded grinding wheel, which also is capable of high-speed operation but which has a dense structure and tends to soften under the heat of prolonged heavy duty grinding, the resinoid-bonded snagging wheel can be made with an open, controlled structure and the bond is relatively unaffected by the heat generated during grinding.

The principal ingredients of resinoid-bonded grinding wheels are the abrasive cutting grains and the synthetic resin bonding agent, to which special fillers are sometimes added.

The proper amount of abrasive grain is weighed out and poured into a mixer. Bond and a plasticizer are added. After thorough mixing, the batch is screened to break up any lumps that may be present. It is then ready for pressing. A steel mold is filled with the correct amount of mix, which is leveled off and pressed to the desired pressure.

Steel reinforcing rings are molded in wheels having large holes where the wheels are to be used for snagging or rough grinding. These rings are not for the purpose of strengthening the wheel, as might be assumed, but to hold together the pieces of a wheel that might break in operation.

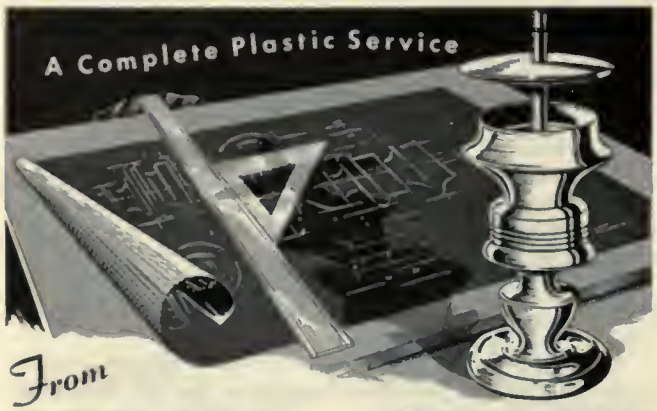
High-Speed Wheels

On certain types of cup-shaped wheels for use on high speed portable grinders, a steel nut is molded into the wheel for convenient mounting purposes. Thin cut-off wheels are molded either with straight or tapered sides.

The wheels are baked in electrically-fired ovens at pyrometer-controlled temperatures. The baking cycle varies from several hours to several days depending upon the size and type of wheel.

After baking, the wheels are trued or machined to their finished dimensions, either with hardened steel cutters, other grinding wheels or diamond cutting tools.

The arbor holes of certain wheels are lead bushed; in others the holes are finished by machining to close tolerances. END



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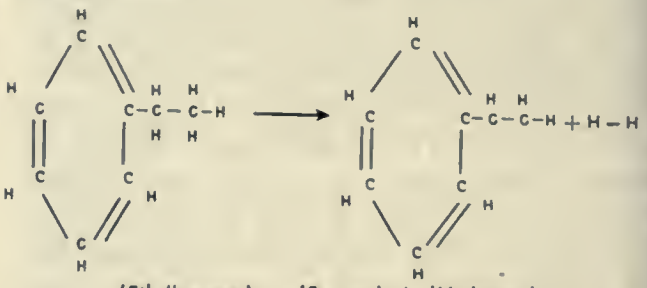
Styrene

(*Continued from page 73*)

alkylation of the benzene and dealkylation of the polyethylbenzenes. Thus nothing comes out of this first plant except ethylbenzene and small amounts of catalyst tar.

The ethylbenzene produced in the first plant is subjected to heat in the presence of a catalyst to bring about the following reaction:



(Ethylbenzene) = (Styrene) + (Hydrogen)

For this purpose steam is heated to around 1400° F, in gas-fired furnaces. This highly super-heated steam is then mixed with vaporized ethylbenzene and passed through a fixed bed of solid catalyst. The heat and catalyst bring about the dehydrogenation of the ethylbenzene, yielding styrene. Less than half of the ethylbenzene is dehydrogenated, the remainder passing through the bed unchanged; small amounts of benzene, toluene, and tar are produced along with the sizable volumes of hydrogen gas produced by the primary reaction. This gaseous mixture of steam, hydrogen unreacted ethylbenzene, styrene, benzene and toluene passes into condensers where essentially everything is condensed except the hydrogen gas. The gas is released to the atmosphere, and the condensed steam and hydrocarbons are separated by gravity separation into a water layer and hydrocarbon oil layer. This hydrocarbon oil layer containing the styrene is forwarded to the third plant.

The third plant involves very little in the way of chemical reactions, the entire process being essentially distillation. In this third plant, the mixture of ethylbenzene, styrene, benzene, and toluene is separated into fractions by distillation in conventional bubble plate columns such as are used in the ethylbenzene plant. These columns vary in diameter from 8 to 10 ft and in height up to 70 ft. This distillation, however, must be carried out with extreme care in order to avoid polymerization of the styrene to solid polystyrene which would fill these large distillation columns with a solid mass and render them useless, a catastrophe, indeed. In order to avoid this polymerization, temperatures must be kept very low and so the distillation is carried out under a very high vacuum and the distillation columns are designed for very low pressure drops through the columns. Small amounts of a polymerization inhibitor are added in the process to further protect the styrene. The ethylbenzene fraction produced

Appearing in the November issue of *plastics*—

THE FUTURE OF PLATED PLASTICS

Written by Raymond R. Dickey, manager of the plastics division, Monroe Auto Equipment Co., the article analyzes the future of this recent trend in plastics. Originally utilized almost exclusively for ornamental ware and jewelry, this field now has wide application in electronic and electrical equipment.

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in this third plant is recycled to the second plant for dehydrogenation until it is completely converted to styrene; the benzene fraction is similarly recycled to the first plant where it is converted to ethylbenzene; the toluene fraction is loaded into tank cars and shipped to the government ordnance plant at Baytown, Tex., for purification to nitration grade toluene; the styrene fraction, which is better than 99.5% pure, is refrigerated to 60° F and shipped in railroad tank cars to the various copolymer plants which are operated by the rubber companies. In these copolymer plants the styrene is reacted with butadiene to produce Buna S rubber.

In the Buna S chemical phenomena, styrene and butadiene are submitted to emulsion copolymerization to produce a synthetic latex. This is coagulated and dried to produce crude synthetic rubber. This crude rubber in turn is passed through a rubber mill and compounded with the necessary materials so that when fed into a rubber press, its vulcanization creates a synthetic rubber tire.

Though war takes the styrene production largely for Buna S, the facilities can immediately be diverted, in part, to plastics production when the heavy war demands for rubber relax. Because of the many good physical characteristics, working qualities, mechanical, electrical, and thermal properties of polystyrene as well as its dimensional stability, it will occupy a significant place in the plastic era to come.

The control of the polymerization process to make a granular thermoplastic material, both in unlimited color possibilities and in crystal-clear transparency, had already been largely perfected by Dow in 1938. The former import price for an impure polystyrene of $1.25 has been brought down to the announced 1944 price of 27¢ per lb.

Methods of forming this thermoplastic polystyrene are by blowing, extrusion, injection molding, compression molding and transfer molding. When cast in special shapes, it can be milled, machined and polished with good results. The purity achieved by Dow has given it better heat resistance and light stability, eliminating crazing and blushing which kept its marketability limited in early years. It has light transmission of 90%, and its unique characteristic of light transmission through rods, carrying it around curves or bends, gives it novel advantages in the illumination fields, such as for surgical examination and instrumentation, unusual illuminated signs, and magnification mounting for biological specimens. It has many optical and decorative possibilities. Its flow characteristics make possible thin sections and films. It has the lowest water absorption of any of the commercially known plastics, and is well adapted to humid atmospheres. Its extraordinary chemical and solvent resistance is not affected by glycerine, naphtha or glycol. Polystyrene is resistant to alcoholic materials, concentrated acids, and alkalies.

This colorless, transparent polystyrene has a refractive index of 1.59, is practically odorless and without taste, is not affected by age, is unaffected by water up to 60° C, has a specific gravity of 1.054 — 1.056. When injection molded, it has a tensile of 5000 — 9000 psi, transverse 14,000—19,000 psi and a compression strength of 11,500—13,500 psi. It has a superficial Rockwell of 15X—89—92. Its electrical properties are advantageous, having a dielectric strength instantaneous of 0.005" thick 3500 v/mil; 0.125" thick 500—700 v/mil. Dielectric constant at 60 cycles is 2.5—2.6, and at 1,000,000 cycles is still 2.5—2.6. It has a power factor between 60 to 1,000,000 cycles of 0.0001—0.0002 to 0.0001—0.0004. Moldings are dimensionally stable through a wide range of temperatures, humidity and loads.

Its extreme inertness, these foregoing characteristics and its electrical properties have earned it an important

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Recent developments have produced large size, rigid, semi-structural moldings hitherto considered impossible. Alden B. Dow, architect, is opening new horizons for plastic materials in the building fields, having developed a molded polystyrene building block of wide design utility and beauty. His development of the model community at Lake Jackson, Tex., within a few miles of the Dow Freeport-Velasco enterprises is one of the most scientific community projects of its kind in the world today.

So, within 100 years from the first discovery of styrene by Bonastre in 1831, a pure polystyrene of almost unlimited commercial significance as a plastic has been evolved. This achievement has made possible the urgent solution of the critical rubber problem, has provided a developed supply almost instantly ready to answer all requirements of the plastic era to follow. END

Velon

(*Continued from page* 34)

standing a temperature up to 170° F without any change in physical characteristics, and to 300° F before melting.

According to Firestone Tire & Rubber Co. manufacturer of *Velon*, its properties include resistance to abrasion, cracking, weakening, perspiration, age, moths and sunlight—factors of extreme importance in upholstery. Its low water absorption (less than 0.1% in 24 hr), its wide colorability, its range from complete transparency to the opaque, also promise to qualify it well for this field. As varied patterns can be woven into *Velon* as into any natural fabrics.

Present indications are that its post-war selling price will be competitive with mohair, wool and part wool, and leather.

Ink, grease, gum, rain and dust—the bane of the average material in this class—can easily be washed off *Velon*. Today, it is already in limited use as upholstery in furniture, and in automobiles, buses, trucks, airplanes, trains, street cars and other forms of transportation. It was found to be a highly satisfactory replacement in strand form for rattan when the outbreak of war with Japan cut off these producing areas in the Far East.

Manufacturing Process

Velon in raw form is a crystalline powder. The yarn or filament is formed by feeding the powder through special patented extrusion equipment in which it is heated above the crystallite melting point and later cooled below that point. After being shaped and super-cooled, it is elongated, while a partial re-crystallization occurs, with the crystallites becoming orientated along the major axis of the yarn. The degree of crystallization may then be controlled by heat-treating after or during elongation in order to achieve properties desired for specific uses. *Velon* is ductile and machinable, can be extruded into tubes or strips as well as threads, and has a glossy sheen.

Velon's value in public buildings lies in its cleanliness, reduction in decorating costs, improved appearance over periods of time, wider selection of fabrics and textural appearance, resistance to various influences which would ruin other materials, washability with soap and water or

other cleaning agents, resistance to hard and constant wear, comfortable feel in hot weather, and nonporosity. In hospitals, its chemical-resistance makes it able to withstand sterilizing solutions.

Combinations of *Velon* with cotton, rayon or other fabrics offer considerable promise in the development of unique and attractive drapery materials.

Early Applications

Among the first uses of *Velon* filament as a finished product was in a box woven type of fabric used as upholstery on the seats of New York's subway trains. Car 1208 of the Independent Subway Division of the city's Board of Transportation has been in operation with *Velon* seats for 4 years, without noticeable deterioration in the appearance and condition of the material. About 110 coaches of the Long Island Railroad have been running for 1½ years with *Velon* upholstery, as have also New York City's bus lines.

Twenty-five leading inter-urban bus companies have installed *Velon* upholstery; also 10 major taxicab companies.

Velon yarn has a tensile strength up to 40,000 psi; is free of grain structure and splitting, thus eliminating danger of damage to clothing from snagging, as often occurs with cane seats; is free from warpage; is dimensionally stable; and resists cutting or slitting with a knife.

Although the material will char when exposed to a direct flame, it will not support sustained combustion. When tested by the New York City Fire Department and the Bureau of Standard and Appeals, a blow-torch was applied to the material, which was covered with gasoline-impregnated excelsior. There was no flame or glow.

In the form of screening it finds application both as home and office window and porch screens and as industrial filter material. The home or building owner can select this screen material in any color desired, so as to attain harmony with the trim or exterior coloring of the structure. This screening does not rust or tarnish, and shares the strength of the more closely-woven fabric. Screens now are used in some 15,000 homes at present.

Velon's value as an industrial filter material stems from the fact that it is not affected by chemical solutions which might destroy other types of filter materials. It also has a resistance to continuous heat up to 170° F, and is not affected by most acids or alkalies. It is, in addition, highly resistant to organic solvents. Its resistance to aging distinguishes it from many filter materials currently in use. Extruded in strands of yarn, it can be formed into filters of varying shapes and gauges and diameter.

At the outbreak of war, *Velon* upholstery had been installed on furniture steamships and was in extensive demand by the owners of the largest fleets. The advent of hostilities, however, suspended this development.

Considerable possibilities exist for the combination of

Characteristics of "Velon"

Specific gravity	1.6-1.75
Refractive index (Nd)	1.6-1.63
Tensile strength (psi)	Up to 40,000
Elongation (%)	25
Resistance to heat (°F continuous)	170
Resistance to heat (°F intermittent)	Shrinks above 170
Softening point (°F)	240-280
Tendency to cold flow	Slight
Water absorption (%)	Less than 0.1
Clarity	Translucent to Opaque
Effect of:	
Fire	Non-Flammable
Aging Effects	None
Acids	None to Slight
Alkalies	None to Slight
Sunlight	None to Slight
Organic solvents	Highly Resistant

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Velon with other plastics, particularly in furniture. Plywood-frame chairs can be upholstered with *Velon* fabric, ranging in fineness of weave from flat rattan to sheerest filament, in any color combination. Acrylics, also, may be used with it in similar fashion.

One of its major appeals in the home and transportation fields is that its hardy physical properties and ease of cleaning render furniture coverings unnecessary. In addition, when the highest grade of pigments become available after the war, *Velon* fabrics are expected to be as commercially sun-fast as any other materials. Although it is tasteless, odorless, and non-poisonous, *Velon* lacks any attraction for termites, moths and vermin, being a synthetic product. Under certain climatic conditions, this quality is especially significant. END

Machining Acrylics

(*Continued from page 28*)

becomes a highly delicate operation where tolerances are to be observed and very often require pretty complex jigs for volume production.

The cardinal principle in the cementing of acrylics is the softening of the contact surfaces. The solution that causes this softening is also the bonding agent. There are two general types of cement in use on acrylics. One is a solvent, of which glacial acetic acid and methylene dichloride are the most prevalently employed examples. The other is the monomer type of cement. This consists of a liquid methyl methacrylate monomer, which is pretty much akin to the substance from which the acrylic plastics itself was cast. Just as the acrylic assumed solidity through polymerization, so the bonding of the cemented surfaces through the agency of the monomer cement takes place through polymerization. Both solvent and monomer cements specifically designed to meet the characteristics of their acrylics are produced by Rohm & Haas for *Plexiglas* and by DuPont's plastics department for *Lucite*. Regardless of which type of cement is used, some degree of heat beyond that of room temperature is beneficial—in the case of the solvent for hastening the softening process and in the case of the monomer cement for hastening polymerization.

Finishing

For a good idea of how important the finishing process on cast acrylics is and how meticulous a procedure it has to be, one need only watch a government inspector examine the finished piece for scratches and other flaws with a magnifying glass. In the sanding process preparatory to buffing and polishing, standard machinery and standard abrasive surfaces are employed. In buffing, however, the buff is either a modification of a standard type or, more frequently, one that is designed by the fabricator himself specifically for acrylics and, even more specifically, for a desired result.

Machine sanders—disc, belt and drum—are used wherever possible. But there are contours to which the abrasive surfaces on these machines will not conform and, for those pieces, flexible-shaft sanding tools, and even occasionally hand-sanding, are applied. In the finishing of sheet edges, a pass through the router is sometimes enough; but, as often as not, a sanding operation is used either instead or in addition. Abrasive surfaces on sanding machines (including the flexible shaft type) are ordinarily operated at about 3000 surface fpm and frictional heat is dissipated by a periodic wetting down.

Considering the fact that, in polishing operations, heat is generated by the revolving buff and that an abrasive

material, fine though it is, is involved, extreme care must be exercised in the amount of pressure exerted by the tool against the acrylic surface. This is true not only in the "ashing" process, but also in "dry" polishing.

Buffing wheels vary in structure and buffing varies in rotational speed depending upon the kind of operation being performed, as well as on the composition of the polishing compound being used. For instance, a soft cotton buffing wheel using a polishing compound of tallow-bound alumina for the removal of shallow scratches would run at about 2000 surface fpm. A polishing operation with tallow alone on an unbleached cotton sheeting buff would use an operational speed of about 3400 surface fpm. A cleaning buff of cotton flannel sheeting without any compound would run at some 6000 surface fpm.

There are so many polishing compounds that almost every kind of polishing requirement is met by one or another. Still, the fabricator will often make combinations of his own that will best suit his purposes or will both improve quality and speed work.

The fact that the subject of jigs and fixtures in the fabrication of acrylics is broached toward the conclusion of the discussion is no indication of its relative importance. In many instances, without jigs or fixtures or both, there would simply be no such thing as volume production of acrylic designs. In most other cases, the efficiency of these devices largely determines the speed with which the work can be put out and, consequently, enters directly into the final cost of production.

Care, accuracy and no small amount of ingenuity are involved in good jig design for the fabrication of acrylics. As apparently simple an operation as a cementing job can be crippled without a fixture properly designed for the purpose. And if that is true of a cementing fixture, which is ordinarily made of wood, it is doubly true of metal drill jigs, in which, for example, the character of the hardened steel bushings alone may determine the efficiency of the operation.

Since jigs and fixtures are usually designed for the individual operation on the particular acrylic piece, no generalizations can be made about them, except this: A clever designer of jigs and fixtures who knows both his machines and the characteristics of his material means a good deal to the customer of an acrylics plant. END

Furfural Resins

(*Continued from page* 40)

good adhesion is due partly to the affinity of the adhesive for phenol-formaldehyde resins. The three block shear method was used in the tests referred to, with the test specimens formed by three blocks measuring 1¼ x 1 x ¼". The center block projects above the others by ¼" and the shear load is divided between two glue lines.

The maximum shear strength indicated by this test, with cure temperature at 85° F and using a 4% catalyst over a period of 7 days, was almost 3500 psi, at which point the phenolic laminated failed completely. Generally, a sound bond can be accomplished with Resin X adhesive overnight at 120° F or after several days at 85° F.

Since Resin X is non-volatile, glue-line thickness of the adhesive is not critical, making possible a technique of casting-gluing in which [illegible] be joined simply [illegible] tween the [illegible] Jo[illegible]

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Plastic Tooling

(*Continued from page* 61)

and put into the oven for curing. The resulting plastic block can now be used for first operation forming and the parts placed on the steel block for final checking.

While production tools are the principal concern of the plastic tooling laboratory, one by-product of its work has been the molding of actual parts, particularly where the number needed is limited, or deliveries are behind schedule. In addition to the propeller cuffs previously mentioned, such items have included a large assortment of switches and handles for use on actual airplanes.

Although principal attention in the initial stages of the Martin plastic tooling research program has been concentrated on thermosetting resins, applications of thermoplastic resins have by no means been overlooked and several interesting innovations have been made in their use and handling. The thermoplastic principally used is *Plastalloy*, an ethyl cellulose compound weighing 68 pcf and made up of two materials, one with a melting point of 325° F. The two materials are cooked for 6 hr in an insulated pot with a sweeping type agitator, the "B" material being added after all of the "A" material has melted. The cooked material is poured against the die which has been preheated to 300° F and is then allowed to cool until the top surface has hardened to a depth of 1", after which a pressure plate is applied to control shrinkage and prevent the plastic from shrinking away from the face of the die. Pressure is applied periodically until the punch and die cool (from 1-3 days depending on size) and after the entire pour has cooled or conditioned (2-4 days) the plate is removed and the top surface of e punch planed level.

ce hermoplastic resins are used primarily for drop ham- of and hydraulic die punches where they replace lead *Plexi*rksite. They are more resilient in forming than Regard l punches, can be cast directly against the die of heat allowance for metal clearance, and weigh only in the s much as lead, making for increased safety since proces ls do not shear off, and easier handling. Some of hasten ber needed with the lead punch is eliminated with stic, and noise is reduced considerably.

Finis only serious limitations of the plastic punch are F ht draws such as channels and 90° bends. On very on draws the rubber will deform the plastic just as it has lead.

exa sting methods for the plastic punches are still in the wi erimental stage at Martin, but one recent innovation to ds great promise as a time saver. Instead of pouring st e plastic directly on the lead, a plaster mold is taken c om the original die pattern, and the punch is pre-molded from this mold. In this way the curing of the plastic is

Properties of "Textolite 1420"*

Compressive strength (psi)	8,000
Flexural strength (psi)	3,000
Tensile strength (psi)	1,500
Shear strength (psi)	3,000
Impact strength (ft-lb per in of notch)	0.25
Rockwell hardness (H scale)	80-90
Specific gravity	1.15
Mold shrinkage (in per in)	7×10^3
Thermal expansion (in per in per °C)	4×10^5
Heat resistance (°C)	Not above 125
Effect of aging	Only change in color
Machining qualities	Good
Specific volume (cu in per lb)	24

*Walnut flour filler.

accomplished while the kirksite die is being made. The finished kirksite die is then reheated and the cured, premolded punch fitted to the die.

Now in the experimental stage is a proposal to carry this principle still further by casting preformed blocks to the approximate size of the punch, chiseling them roughly to contour, and then molding the finished punch by reheating the kirksite die.

A second time-saving innovation is the planing level of the top surface while the punch is in the hammer with a small hand router attached to the ram of the hammer.

Considerable savings in attaching the plastic punches to the ram have been achieved through the use of ½" lag screws in place of the conventional ¾ or ⅞" studs used with the lead punch, thus eliminating the necessity for predetermining the position of the bolts.

In casting hydraulic draw dies from the plastic material, it has been found possible to cast the punch and draw ring as a single piece, due to the light weight of the material, and then saw them apart, eliminating one casting operation. However, it is still preferable to use a kirksite draw ring wherever possible.

Thermoplastic plastics have also proved adaptable for blanking punches where the preparation of steel punches involves a great amount of machining time. The plastic punch is molded directly from the steel die and can be refaced as often as necessary. Where the quantity of

Properties of "Catalin" Cast Resins

	ASTM Test Method	Temp. (°F)	R. H.(%)	Electrical and Mechanical Grade (Common Values)
Specific gravity				1.305-1.315
Specific volume—(oz per cu in)				0.751
Refractive index				1.59-1.61
Light transmission (%)				0-1
Colors				White
Machining qualities				Excellent
Water absorption (24 hr %)				0.4-0.6
Inflammability				Non-Inflammable
Effect of aging				Hardens & Yellows
Effect of sunlight				Yellows
Tendency to cold flow				None
Tensile strength (psi)	D48-41T	77	50	8,500-10,000
Modulus of elasticity in tension (psi)	D48-41T	77	50	3.75×10^5
Compressive strength (psi)	D649-41T	77	50	20,000-25,000
Flexural strength (psi)	D650-41T	77	50	10,000-12,000
Maximum deflection under flexure (in)				0.14
Impact strength (Izod ft-lb per in of milled notch)	D256-41T	77	50	0.48-0.60
Shear strength (1" diameter plunger)				5,000-7,000
Hardness, Rockwell		77	50	M65-M80
Volume resistivity (megohm-in)	D257-38	77	Dry	$1—7 \times 10^6$
Dielectric strength (short time v/m)	D149-39T	77	Dry	350-430
Dielectric strength (step-by-step v/m)	D149-39T	77	Dry	260-335
Surface resistivity (megohms)				6.5×10^6
Thermal conductivity—(10-4 cal per sec per sq cm/1° C per cm)				3-5
Thermal expansion (linear coefficient of per °C)				$8.1—10.9 \times 10^{-5}$
Heat distortion point	D648-41T			113—176°F
Effect of hot flames				Chars
Effect of weak acids				(Note 1)
Effect of strong acids				(Note 2)
Effect of weak alkalies				(Note 3)
Effect of strong alkalies				Decomposes
Effect of organic solvents				(Note 4)

1: No effect to slight decomposition dependent upon the acid.
2: Decomposed by oxidizing acids. No effect to slight effect by reducing and organic acids.
3: Slight effect to marked effect dependent upon the alkali.
4: No effect to complete disintegration dependent upon the solvent.

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parts to be produced is small, it is far easier to re-face the plastic punch a few times than to machine a steel punch, while for larger quantities a steel face can be attached to the plastic punch. When used without the steel face, finished parts blanked with the plastic punch require little or no burring.

As in the case of thermosetting resins, thermoplastics have also proved adaptable to many minor items at Martin. One such application is hand dollies for hand forming material to steel or wood blocks in the sheet metal department. Here a master mold is made and the dollies are poured as needed. Formerly they were made from hard wood or fibre and had to be individually carved.

And as a by-product, these same thermoplasties, with a plasticizer added, can be used to protect threaded parts. The parts are dipped in the liquid plastic to coat them until ready for use, at which time they can be easily unwrapped by nicking the plastic with a fingernail. END

Textiles

(*Continued from page* 21)

This resin treatment is also applicable to cotton and rayon goods. Up to the present, cottons have been shrunk by the Sanforizing process which is an excellent mechanical method which takes up the residual shrinkage in the fabric. There is a problem in the mechanical shrinkage of rayons and spun rayons resulting from the slippage of the fibers. It is here that the chemical stabilization of the fabric with *Resloom* shows particular promise, possibly in conjunction with Sanforizing, to remove the last traces of shrinkage after the *Resloom* has been applied to prevent the major portion of the shrinkage. On woolens and worsted London shrinking has found general application and the application of *Resloom* to the wool opens up the possibility of greatly reducing the yardage of fabric lost in this shrinking process. This would be an important development.

Properties of "Resloom"

Resloom M-75 is a clear, colorless resin having a specific gravity of approximately 1.20. It is stable under normal storage conditions, and may be readily diluted with water to any desired concentration. It is usually supplied at a pH of 9.0 to 9.5. The following tables list the organic solvents with which it may be diluted and with which it is miscible.

Solvents or Diluents
Methyl alcohol
Ethyl alcohol
Isopropyl alcohol
Butyl alcohol
Propylene glycol
Glycerine
Acetone
Cellosolve
Glacial acetic acid
Ethyl acetate (slightly soluble)

Non-Solvents
Carbon tetrachloride
Solvesso
Toluene
Diethyl ether

If the pH of M-75 solutions is dropped below 7, it polymerizes to a water-insoluble, solvent-insoluble resin. The rate at which this change takes place may be adjusted by controlling the pH and the temperature. Low pH and high temperatures give the quickest change.

The cured and polymerized M-75 is unique and outstanding in its solvent resistance and complete insolubility in all types of organic solvents. It also shows excellent resistance to acid and alkali. These properties make it of

TABLE I: Density of Resloom M-75 in Aqueous Solutions

Parts of Resloom M-75	Parts of Water	Baume Solution	Twaddell Solution	Approx. Density of Solution
100	0	23	38.0	1.19
50	50	10.8	16.0	1.08
20	80	5	7.2	1.036
16	84	4	5.6	1.028
12	88	3	4.2	1.021
8	92	2	2.8	1.014
4	96	1	1.4	1.007

outstanding value as a textile resin, since fabrics treated with the M-75 are impregnated with a resin which is fast to washing and dry cleaning and should last the life of the fabric. No satisfactory method has been developed for removing the resin from the fiber. A nitrogen analysis of an M-75 treated cotton fabric gives a measure of the resin content, but wool fabrics which already contain nitrogen are extremely difficult to analyze.

The resin content of an application bath may be determined by its Twaddell or Baume. Table 1 gives the specific gravity of M-75 solutions diluted with varying amounts of water. The resin content of a bath may also be obtained by evaporating a sample of the solution to constant weight at a temperature of 105° to 110° C.

Fixation as Measured by Dyeing Rates

When a cotton or rayon fabric is cured with *Resloom* M-75, the rate at which it can be dyed is retarded. An uncured fabric will dye a deep shade in 10 min at the boil with 3% Diamine Fast Blue FFB (Prototype 71). A properly cured fabric will give a very light shade under these same conditions.

With 3% diammonium phosphate used as catalyst, and a 10% aqueous solution of *Resloom* M-75, curing times and temperatures shown in Table 2 were found necessary to give a maximum resistance to the dyeing of cotton sheeting.

Curing at 225° F for 1 hr does not give as good a cure as a very short time at the higher temperature. Apparently, temperatures of 225° F or better are required to flow and condense the resins. •

Catalysts

Besides diammonium phosphate, other acid forming salts which may be used as catalysts are ethyl ammonium phosphate and ammonium phosphate. Ammonium sulfate and ammonium chloride are normally considered too strongly acid for safe use on cotton goods, although they give a rapid cure.

With heavy fabrics such as blankets, appreciably longer times are required for curing to insure thorough penetration of heat into the center of the goods.

Soft or Stiff Finishes

To obtain a soft finish, the *Resloom* resin solution must be impregnated into the heart of the fabric or fiber, and the use of penetrating agents such as Santomerse D is desirable. A 10% solution of M-75 thoroughly penetrated into the fiber will give a very soft, mellow, full finish. A

TABLE 2

Time (min)	Temperature (°F)	(°C)	Comments
+30	225	107.2	Not as good as 10 min at 250° F
10	250	121.1	30 min at 250° F shows no improvement
4-5	275	135	3 min is nearly as good
2-3	300	148.9	2 min is nearly as good
1¼-2	325	168.8	1 min is not quite long enough

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TABLE 3: Time and Temperature to Cure Resloom M-75

(in the presence of 3% $(NH_4)_2HPO_4$)

Time (min)	Temperature (°F)
10	250
5	275
3	300
2	325

2% solution in alcohol cures on the surface of the fibers and does not penetrate, giving a very stiff, boardy effect. By controlling the penetration, it is possible to control the stiffness or softness of the finish.

Preparation of Resin Solution

For most applications, a 10% aqueous solution of M-75 is adequate. Ninety parts of soft water are mixed with 10 parts of the resin. Three per cent (based on the weight of M-75) of diammonium phosphate as catalyst is added to the diluted resin solution when it is ready to use. The resin-catalyst solution *should be* stable for at least 24 hr at room temperature. 1% of a wetting agent such as *Santomerse* D should be added to the bath to insure good penetration and softer finishes. Penetrating or wetting agents must be neutral. Softeners may also be added to the resin bath, and the cation type are recommended.

The surface resin gives a stiff, firm effect, and thoroughly penetrated resin gives a soft effect. Where soft effects are desired, it is essential to scour the fabric thoroughly to remove all grease, oils or sizing materials. Where tightly woven goods are being impregnated, it is preferable to use a three-bowl mangle. The goods must be given a very tight, hard squeeze to remove surface resin and drive the M-75 solution into the heart of the fibers. Softest results are obtained when the impregnated goods carry 60% to 80% of their weight of M-75 solution.

The treated fabric is dried to width on the usual drying equipment. It is essential to dry at width, as the powerful stabilizing effect of the resin makes it very difficult to get back to full width a fabric that has been dried and cured in the slack condition. Properly cured fabrics hold their full width after repeated washings.

A fabric in drying and curing usually reaches a temperature 10-20° below the dryer temperature. The times and temperatures needed to cure the resin after all the water or moisture has been driven off the fabric are shown in Table 3.

Since the cured resin is slightly acid, it is necessary to wash out the last traces of this acidity before the goods are stored or shipped. An alkaline spray may be used to accomplish this effect when goods cannot be washed. It is essential to wash after curing to remove traces of surface resin to give a softer finish. Softening agents may be incorporated in the washing solution or final rinse. Goods may be dried to width or Sanforized after treatment with the M-75, but little shrinkage will be noted.

Syton

The significance of the *Sytons*, a recent development of Monsanto laboratories, is their ability to impart slip resistance and increased friction to textile fibers and fabrics, particularly to the short staple fibers such as cotton, spun rayon and wool. They also effect a reduction in luster, which is of particular interest on filament rayon fabrics and on worsted suitings that have worn shiny.

While *Syton* is, strictly speaking, polymerized silica or SiO_2, it may be characterized as a true inorganic resin in the sense that it is a polymerized compound which, on drying, deposits a tough, continuous film. One great value of *Syton* lies in the fact that it is effective in very low concentrations, for as little as one-fourth of 1% *Syton*

Typical Effects Obtained with "Resloom M-75"

REDUCES	INCREASES
SHRINKAGE of woolens, worsteds, cottons, rayons, knit goods	FASTNESS of direct colors
FELTING of woolens, worsteds	RESILIENCE of cottons, rayons
SNAGGING of hosiery	BODY of cottons, rayons
SLIPPAGE of filament rayons	FULLNESS of rayon-cotton mixture
WATER PICK-UP and moisture-regain of cottons, rayons	WEATHER-FASTNESS of starches, dextrins
	CROCKING-RESISTANCE of most dyestuffs

GENERAL

Acts as a bonding agent between fibers and fabrics
Produces durable luster on cotton chintz
Imparts hydrophobic character to rayons

will markedly reduce the slippage of sheer rayon. The fine fibrils are sub-microscopic and penetrate the coarse textile fibers and yarns.

It may be diluted with water or solvents, and is stable in mild acid or alkali. Strong acids will cause a gradual gelling, and strong alkali will cause a product precipitation. On drying, it deposits a very hard, non-tacky, translucent film. The film hardens the surfaces of fibers and greatly increases their coefficient of friction.

Besides the three applications already referred to, the *Sytons* also can be used whenever a powerful colloid with film-forming properties is required. For example, they greatly increase the wear of fine-knit goods, reduce tackiness and stickiness during resin applications, deluster resin coatings, deluster all types of fabrics and yarns, impart a full-bodied permanent finish to fine fabrics and a clear crisp finish to cottons and rayons, improve the wear and fullness of all types of fabrics.

No special precautions are required in the application of *Syton* W-20. For most applications a 2% to 5% solution will give the desired effects. One part of the resin is diluted with 50 parts of water and is applied on a padder to the fabric, drying in the usual fashion. There is no evidence of substantivity or exhaustion from a standing bath, although under certain pH conditions there may be some absorption. No curing or after treatment is required to fix the *Syton* and render it washfast. Furthermore, it may be applied from a neutral solution without any after-treatment of acid or alkali.

Higher concentrations such as 4% to 6% solutions give a crisp or firm finish on fabrics which breaks down on washing. However, the body and fullness of the fabric is retained after repeated washings, indicating that the silica is retained in the fiber. The finish produced is quite crisp. Although a calendar, button breaker or the action of a washing operation will break down the crispness, it will not remove the resin. END

All-Purpose Bonding

(*Continued from page 32*)

As a further example of how *Pliobond* already is being used, Goodyear officials point to the spectacular accomplishment of adhering a synthetic rubber band to glass, ceramics and metal in ordnance equipment to provide a flexible seal against water and moisture vapor seepage. Other recently-perfected uses include bonding synthetic rubber to metal in aircraft engine carburetors; in the production of submarine cables and in mounting dies for printing on cardboard cartons. In addition, the material used to seal the joints in the metal cases of electrical motors permits these motors to operate even while they are immersed in the fuel cells of an aircraft.

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Sheet rubber is being attached also to vitrified abrasive wheels for elimination of vibration and noise, while other war uses of *Pliobond* include adhering wood and plastics to metal in radio-testing equipment, assembling canvas to plastic, rubber to leather, paper to leather, canvas and other fabrics to metal and felt to cardboard. Quantities of *Pliobond* are being tried experimentally also in laminating lead foil, paper and fabric. END

Plastics Hold War Gains

(*Continued from page* 68)

This material may be repaired with cellulose tape and its breakage resistance is then almost as high as that of a solid undamaged piece.

Though slightly more expensive than window glass, the laminate costs only half as much as safety glass. It is therefore likely to replace these materials in the post-war window glazing business.

By the end of 1943, only 30 of the typical applications made by the Navy had resulted in the saving of 3,500,000 lb of aluminum, 2,000,000 lb of brass, 100,000 lb of bronze and 400,000 lb of rubber, as well as more than 500,000 man and machine hours and an appreciable amount of money. Other critical materials for which plastics acted as an effective pinch-hitter were iron, steel, chromium, nickel, zinc and copper (aside from their use in the alloys mentioned above).

Important as this role was for the plastics industry, it was not nearly as significant as the fact that, even when the replaced metals became more abundant, plastics continued to be used by choice. There were two reasons for this: (1) Either the use of metal was merely traditional without any special functional value, or (2) plastics had proved themselves superior for the particular application.

As an example of the first kind, hardware for furniture trim may be cited. Brass and bronze had been used for this purpose simply because they had "always" been used. But plastics materials performed the function just as well and had the additional advantage of lightness and more varied decorative possibilities through color. The building and diverse equipment industries may well follow suit.

Another typical example is the deck clock installed on war and merchant ships. Cases for these timepieces formerly were manufactured from expensive brass castings which had to be machined and polished. Even after installation, these cases were a steady drag on manpower since they had to be polished regularly by deckhands.

Because of the scarcity of brass, the clock manufacturer subcontracted his case to a small plastics concern. On this one project alone it is estimated that 275,000 lb of brass had been conserved for more important usage. Fully as important was the case in the forming of the plastic in steel dies, conserving 24,000 man-hours of labor and 18,000 machine-hours compared with the previous use of brass.

There are several striking examples of plastics replacing metals because they were superior for their purpose. A plastics buoy developed by the U. S. Coast Guard is not only much lighter than the steel it replaced, but has greater resistance to corrosion. A mahogany veneer plywood bonded with phenolic resin makes an excellent binnacle stand, dispensing with all but a scant dozen pounds of the 250 lb of brass formerly required. The alidade, a surface lookout by means of which the position of objects in the direct line of travel of a ship may be determined, was formerly made of aluminum. The metal has been permanently replaced by a plastics material.

There are borderline cases in which other factors determine whether plastics or metals should be used. The Navy ordinarily calls for the heavy duty bronze handwheels for valves. When bronze was on the critical list, plastics laminates were developed which gave satisfactory service. While the bronze handwheel is still preferred when material is available, due to its greater strength and ability to withstand abuse, low heat conductivity and non-skid grip of the plastic are of decided advantage in some instances.

Discounting the doubtful and borderline cases, a review of the applications in which plastics have come to stay is impressive enough. As gasket and sealing materials, the vinyl resins, together with *Neoprene*, have been used extensively. The styrenes and phenolics make up any number of components of radio and radio-frequency devices, coil forms, switch and other handles, plugs and sockets, dials and mounting panels. The housings of thermometers, barometers, and other apparatus have gone over to phenolics, while that of the circuit breaker known as "finger box" has been made of acetate butyrate for some time. Name, data, and instruction plates attached to the diverse motors, pumps and controls of a ship's equipment are all of plastics materials.

For safety treads at entrances to doors and hatches, abrasives imbedded in synthetic resins bonded to canvas are used. Plastic paints protect ships' bottoms against barnacles.

For spare parts boxes and certain types of low-grade bearings not subjected to constant pressure, the laminates have proved their worth.

Like the Army, the Navy is also using a bayonet scabbard (illustrated in "Plastics at Work" section, this issue) made of cotton duck impregnated with cellulose acetate butyrate. This material is lighter and more dimensionally stable than the wood, leather and canvas combinations previously used.

The utility boat hull made of plastics-bonded plywood has been a notable success in war, and post-war plans for civilian use are already afoot. (This hull was described in the July issue of PLASTICS.)

Vinyl resins are being used by Army and Navy to protect guns and other equipment against water and the elements—later on, civilians will want that same protection on their coats and fabrics. Vinyl resins are also being used for insulating the miles of electrical wiring of ships; dyed in many colors, they permit maintenance men to identify more easily the particular cable of the labyrinthine installation they want to get at. After the war they should be a formidable competitor of the rubberized fabrics in the automotive and other industries as well as on ships.

The plastics items used by the Navy Air Arm have become familiar even to the general public: the acrylic gun turrets, bombers' noses, windows and cockpits; the plastics-plywood wings, tail parts, and pilots' seats; the canvas-filled phenolic bomb-racks, 14 lb lighter than those of aluminum or magnesium. Less familiar is the melamine formaldehyde housing for the distributor mounted on the Wright radial engine which has a higher resistance to arcing than rubber, and the airplane flooring of laminated phenolic and phenol-impregnated fabrics which reduces the weight of a 50-ton bomber by 400 lb. This ought to give the building industry a lead, as will the polystyrene plumbing fixtures developed by the Bureau of Yards and Docks.

This branch of the Navy has also sponsored the use of plastics in light reflectors and miscellaneous hardware—both applications opening the way to wider use of plastics.

The Medical and Surgery Branch is using a hypodermic syringe made of cellulose acetate butyrate, which

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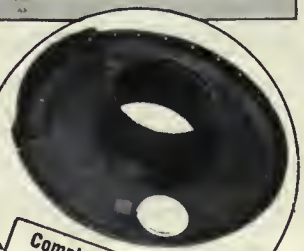

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also forms the pump furnished in a snake-bite kit for drawing out the serpent's poison from a patient. The same branch has had tubs for foot baths made of plastics. Fungicidal solutions are placed in them to ward off athlete's foot, a widespread affliction in the camps. Public gymnasiums and sports clubs will be able to use such tubs in their club-houses.

An outstanding example of a product sponsored by the Navy which will find extensive post-war application for purposes other than that for which it was developed is the vinyl-phenolic formulation patented as Navy Case 3436, which has taken the place of leather for a binocular carrying case. It is a laminated and molded plasticized vinyl resin strengthened by fabric impregnated with phenolic resin. Impervious to weathering which makes short shrift of leather, it also has high impact, flexural and abrasion resistance; it does not promote fungi growth, as leather does in a moist atmosphere. Under severe tests, the laminations hold firm and the surfaces remain unblemished. No color comes off to stain hands or clothing. With such versatile properties, the material seems to be a natural for many civilian uses where leather is now used—luggage, briefcases, and scores of related articles. How great that need was may be gathered from the fact that the Army and Navy purchased some $30,000,000 worth of the material; and that figure may be an index of what the peacetime sales will be.

One of the most important results of wartime plastic developments is that ideas have been turned over to private industry as a whole for development. In the beginning, some manufacturers were reluctant to carry on their work in this fashion. They thought they might do better for themselves by reserving certain parts of their findings for their own use after the war, fearing that they would be at a disadvantage beside their competitors if they revealed their processes. But, it later became apparent to all that it was in their best interests to pool their efforts, for in helping to win the war they would also be helping to expand the entire industry at a pace far more accelerated than they could possibly hope for without such cooperation. That was no idle promise—it has become a reality. And what has been achieved in this way under the stress of war undoubtedly will yield rich fruit for the industry as a whole in the days of peace to come. END

Continuous Injection, Extruding

(*Continued from page 74*)

automatically shuts off the feeder. Curing time has been cut about 93% as a result of this uniform feed and even mixture of materials. Flash waste is eliminated entirely, except where multiple molds are used, since material which flows from one mold to the other must be trimmed.

While the die clamping capacity of the machine is 450 tons, the screw feed will fill any mold held at any pressures beyond that.

When the back pressure causes a stoppage in the flow of material, the worm reverses and keeps materials in the heating and feed chambers pliable and ready for the next injection. The entire machine weighs 6000 lb as compared with 72,000 lb for another machine developed to accomplish one of the operations possible with the new unit. Walter P. Cousino, a project engineer, developed the machine over a period of 3 years from a piston-type injection machine, to which was added the worm screw feed, the turbulent heating chamber and a method for reversing the worm so material left around it after an operation would not lose proper texture and temperature. END

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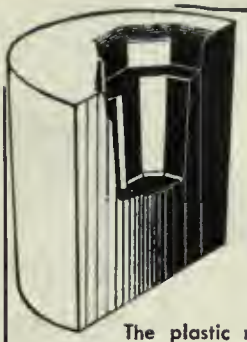

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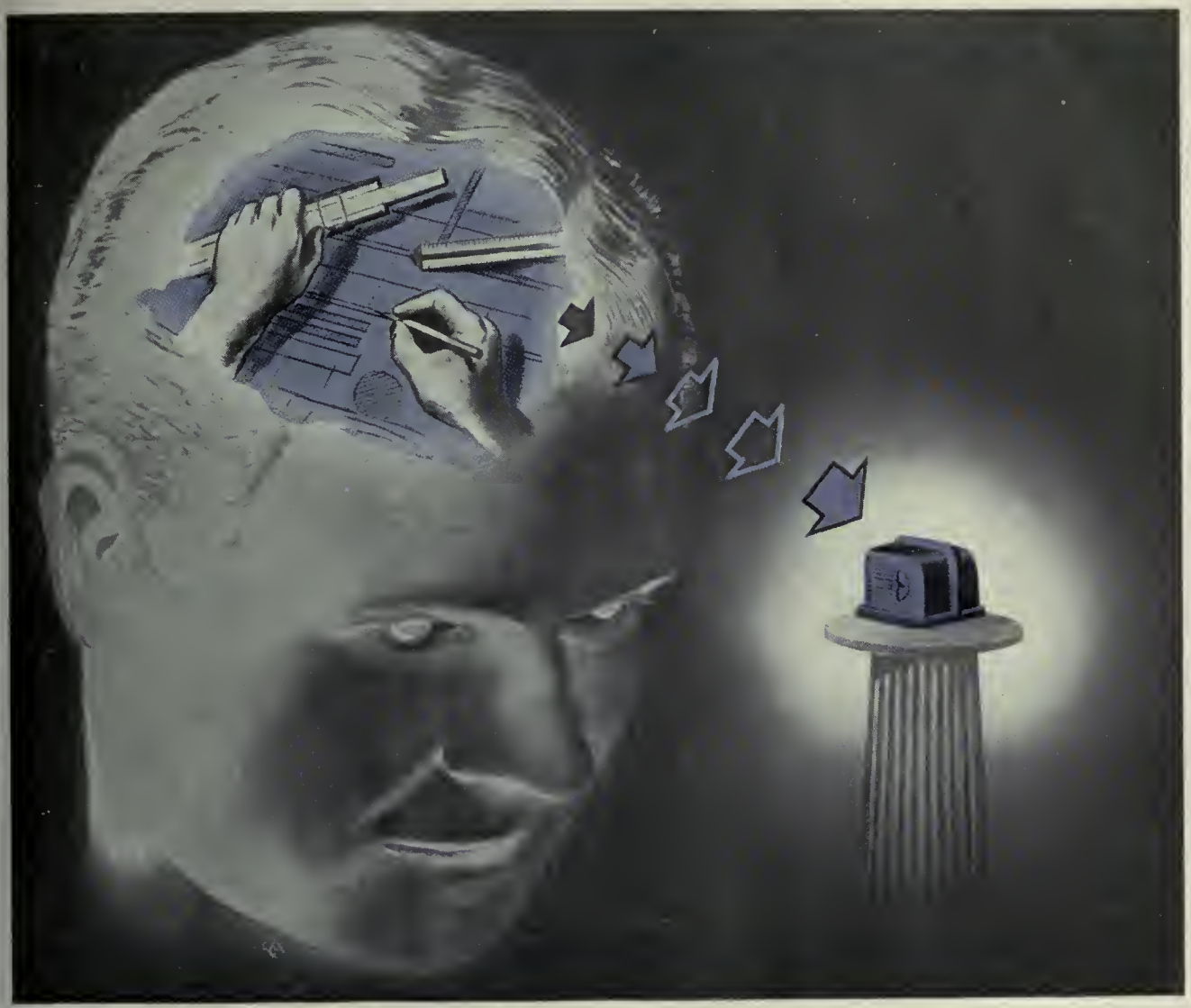

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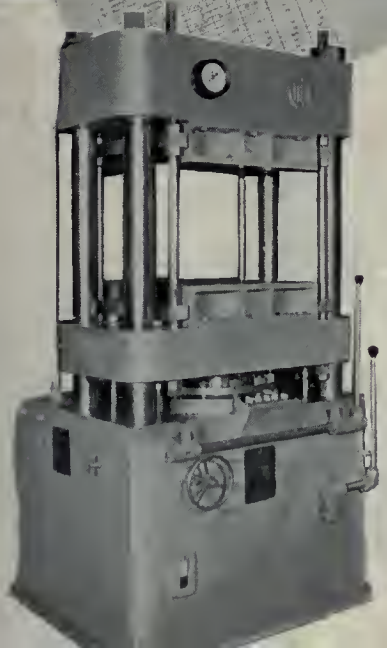
Investigate Why H·P·M PRESSES Are The Most Modern For Compression Molding



The self-contained H-P-M "All-Hydraulic" press offers compression molders many exclusive features which result in lowering manufacturing costs. Bulletin 4403 tells why progressive molders are choosing H-P-M Compression Presses for their production molding requirements. A complete analysis of the self-contained press vs. the accumulator operated press is included. The relationship of the primary elements of the H-P-M oil-hydraulic operating system plus "how it works" is another important section. If you are operating compression molding presses, or plan to, we believe that you will find Bulletin 4403 informative and interesting. Write today for your copy.

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METAL PLATING ON PLASTICS

plastics

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Those are just a few of the properties of GEON ... may be obtained in an almost limitless variety of combinations. The list includes these additional ones: resistance to acids, alkalies, foods, fats, oils, greases, mildew, light, air. GEON materials may be flexible, waterproof, odorless, tasteless. GEON can be compounded to resist flame. It can be made in a wide range of colors. Film, sheet or coatings can be heat sealed.

Right now GEON is available to industrial users subject to allocation under General Preference Order M-10. However, limited quantities can be had for experiment—and our development staff and laboratory facilities are available to help you work out any special problems or applications. For more complete information write Department U-1, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, E. Ninth and Prospect, Cleveland 15, Ohio.

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Vinyl Resins & Plastics

CHEMICAL DIVISION
THE B. F. GOODRICH COMPANY
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We're behind the 8-ball

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Is Touch and Go
Between a Flop and a Message
When it Appears in Print.
We Hear a Lot about
Cancellations.
Right now they just Ain't.
If anything, the Pressure for
Plastic Production for War
Is getting even Tougher.
Like Everyone Else
We would like to Hedge
By taking Civilian Orders.
But we have No Ideas
As to When we can Produce.

Maybe we are Not Smart—
But we are Staying in this War
And can only Hope
We won't be Too Far
Behind the Eight-Ball
When those Telegrams Come In.
Meantime, if you are Thinking
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Booklet "A Ready Reference to Plastics"
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Write for it On your Letterhead—
So if you Buy from Anyone
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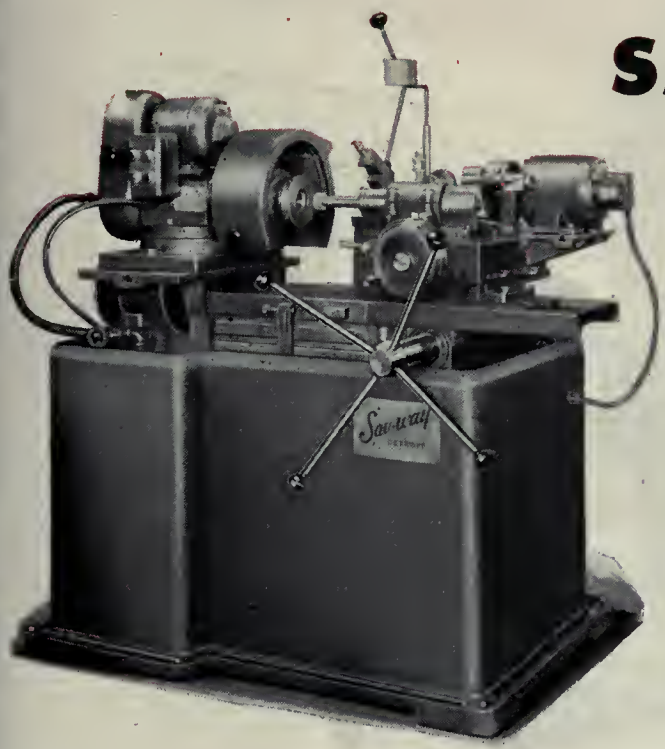

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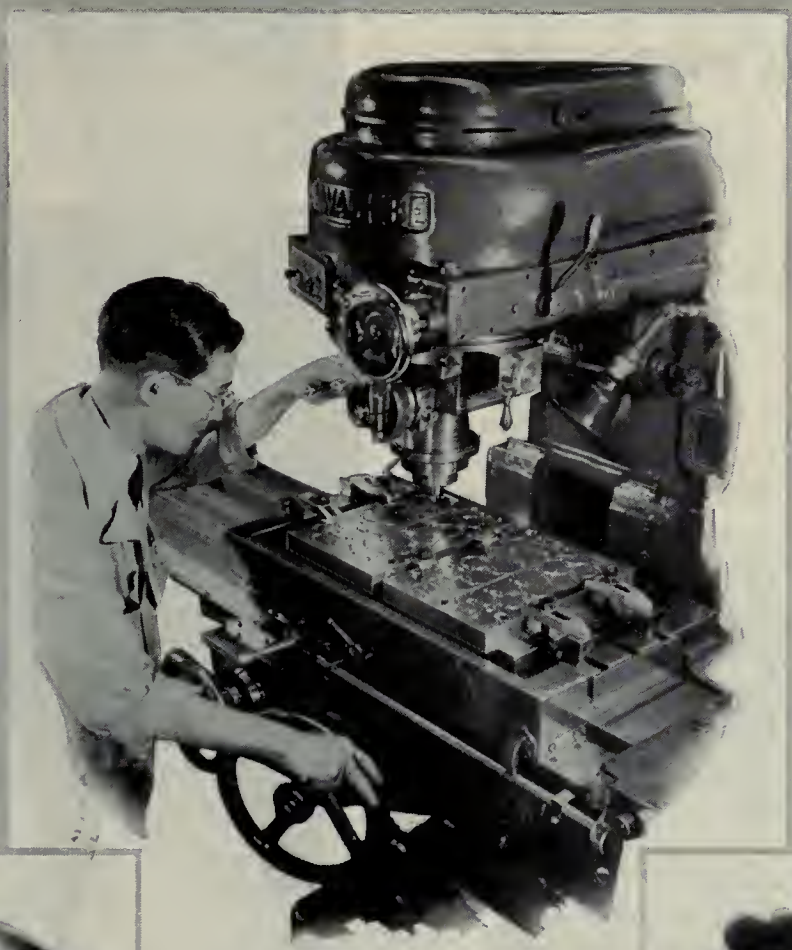
Please address your letter "Attention Dept. E"

Could you Mill this 14 Cavity Mold complete in 52 Hours?



Close-up view of cavities in the solid mold block.

Plastic shower-curtain hooks in multiple, as they come from the mold.

Photos — Courtesy The Kampa Manufacturing Co.

1000-P

This 14-cavity plastic mold is a "sticker" if you try to produce it by ordinary methods — but read this report of its production with the Milwaukee Rotary Head Milling Machine!

The Milwaukee Rotary Head method made it possible to set up both halves of this shower curtain hook mold on the machine table. One cavity of each shape was then laid out by means of a scriber held in the machine spindle. Each milling operation was first performed on the location of the layout and then repeated for each additional cavity. Uniform and unvarying precision is repeated by this multiple origination of cavities with the Rotary Head Method. Total milling time complete — 52 hours.

Write for Bulletin 1002-C for full information on this unusual machine tool and the Rotary Head method of milling.

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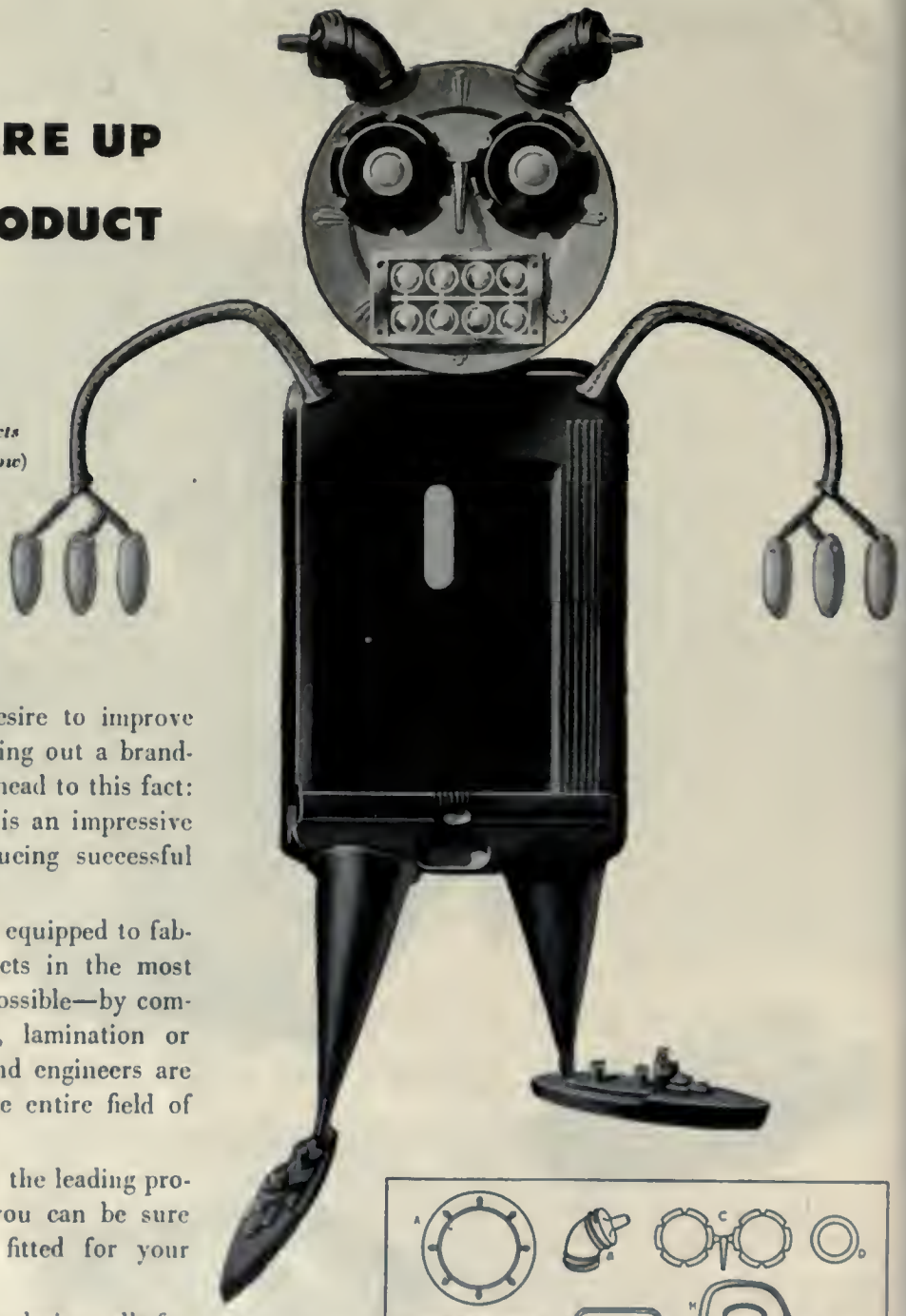
HOW TO SCARE UP A BETTER PRODUCT

(Can you name the different products in this scarecrow? See chart below)

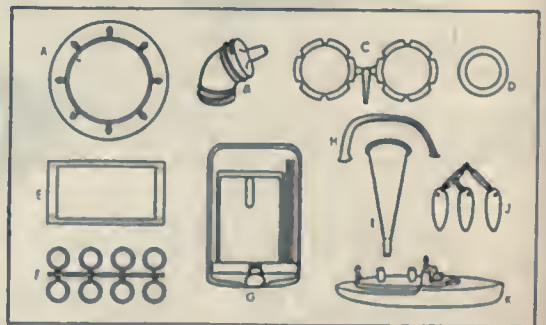


If you're haunted by the desire to improve your present product or to bring out a brand-new product, don't hide your head to this fact: Back of our Plastics Division is an impressive record of planning and producing successful plastic products.

Not only is Continental now equipped to fabricate a wide range of products in the most efficient and economical way possible—by compression, injection, extrusion, lamination or sheet forming; its designers and engineers are among the most skillful in the entire field of plastics.

These men work closely with the leading producers of raw materials. So you can be sure we'll select the plastic best fitted for your requirements.

No matter what qualities your design calls for—beauty, toughness, lightness, durability or any others—come to Continental. You'll find an alert, progressive organization equipped to give sound, practical advice and assistance at all times!



(a) Dish—compression; (b) Nozzle for intravenous bottle—compression; (c) Color lenses—injection; (d) Button—injection; (e) Label holder—injection; (f) Flashlight lenses—injection; (g) Billing machine housing—compression; (h) Air scoop mounting—compression; (i) Funnel—compression; (j) Fishing lures—injection; (k) Toy boat—injection.

CONTINENTAL CAN COMPANY, INC.

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SHEET FORMING • LAMINATION

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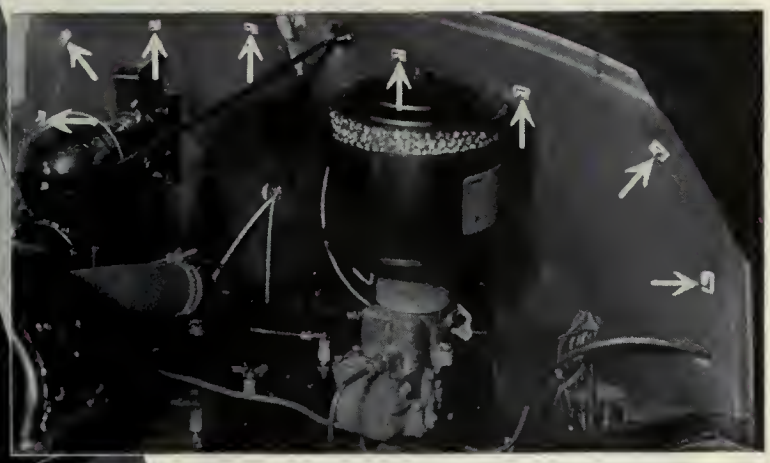
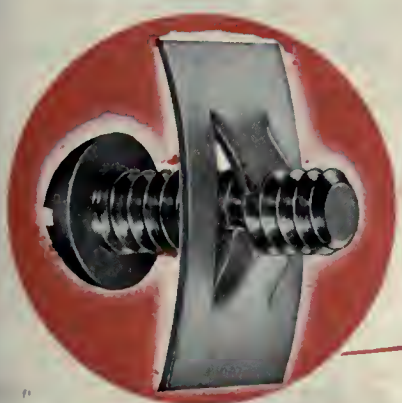


★

NO WASHERS NEEDED

WIDER BEARING SURFACE

● Illustration above shows SPEED NUTS used in fastening insulation to automobile engine dash. By providing a wide bearing surface they eliminate spanner washers and prevent tearing of the insulating material. Left illustration shows typical warm air furnace construction on which SPEED NUTS are used throughout the entire assembly. Threaded nuts and lock washers were replaced at a saving of over 50 per cent on [illegible]. SPEED NUTS provide a double-locking Spring-Tension grip that [illegible] stress and strain caused by expansion and contraction, and they also prevent any loosening from vibration. In writing for literature, please request details of Flat Type SPEED NUTS.



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Speed Nuts* Patented

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FASTEST THING IN FASTENINGS

"I'M THROUGH WITH PLASTICS!!!"

The old man was really sore. His production engineer couldn't get a word in edgewise. "I'm through," he repeated. "These plastics are no good. Just *look* at what's happened to those units. If that plastics salesman comes around here again, just send him in to me!"

We sympathize with the "old man," but he really ought to learn that the term "plastics" embraces scores of different materials having widely varying characteristics. He bought trouble when he was sold a highly regarded plastic that was totally unsuited to his job.

If you have a production problem which you think might well be solved in plastics, you can proceed in two ways. One method is to thumb through a list of plastics manufacturers and give each salesman a chance to push his product. The other method is to "Call on Creative" and let an expert, with no particular material to sell, study your problem and advise you which type of plastic, *if any*, will do your job best.

Creative has no plastic axe to grind. It produces plastic parts made from laminates, cast phenolic resins, methacrylates and acetates, to mention only a few materials.

We have no ties to any particular type of plastic and we decide independently which plastic we will recommend for your job.

Get the habit of applying our "know-how." . . . Call on Creative.

Creative

PLASTICS CORP.

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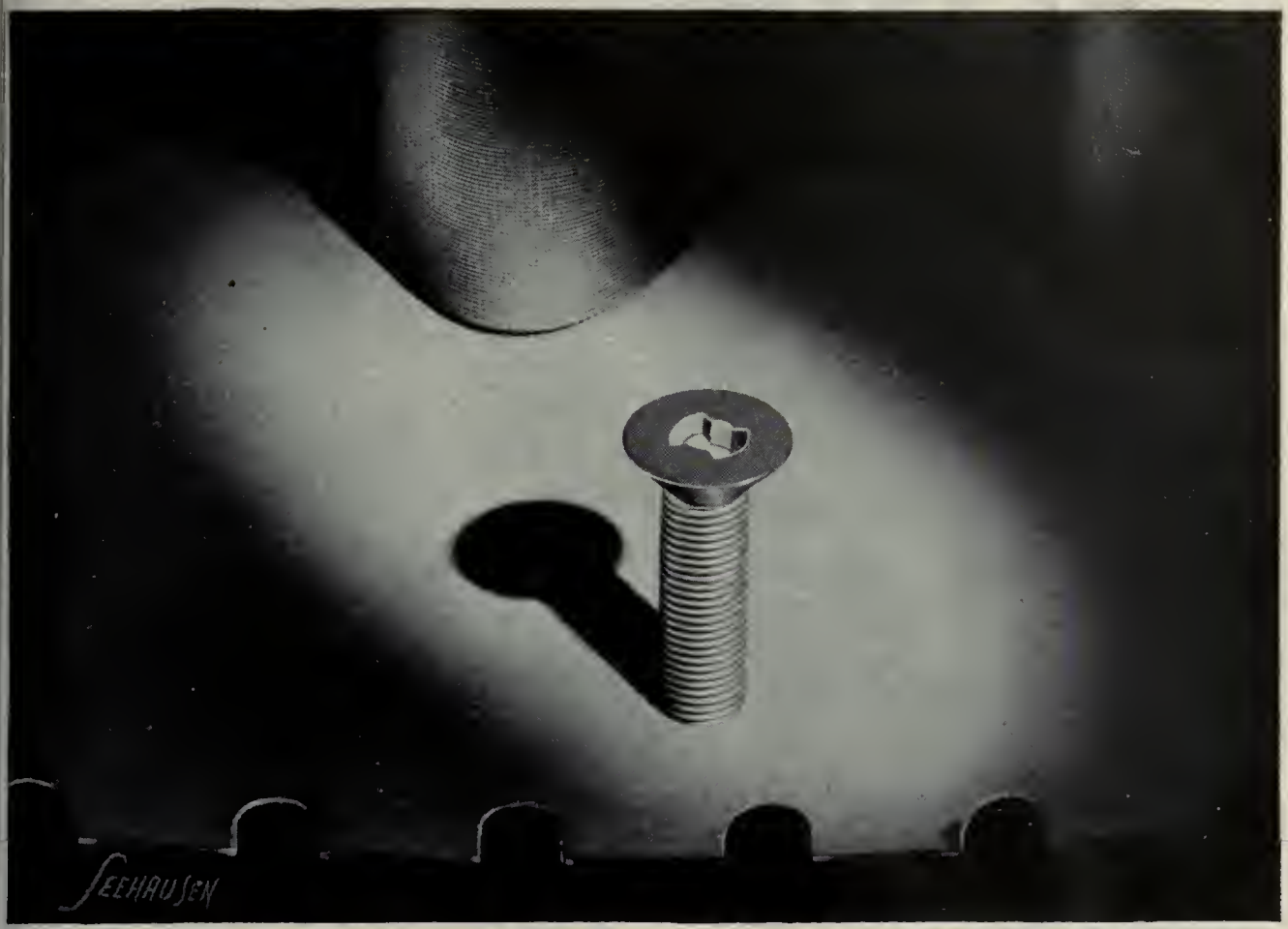
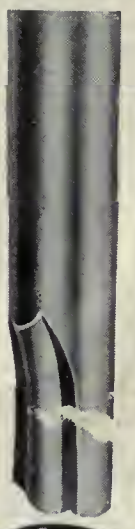
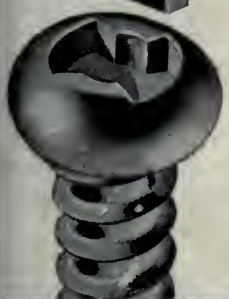




A Star Performer is conceded the center of the stage . . . *only* by virtue of outstanding merit. In the field of fastenings, CLUTCH HEAD is a star performer by any measure of comparison. It gives you every conventional advantage offered by any or all other assembly line screws, *plus several exclusive features that are not matched by any other screw on the market* . . . features that definitely contribute to reduced cost through higher speed, greater safety, and effortless ease in driving. CLUTCH HEAD also simplifies field service problems as no other screw can because the Clutch recess is designed for operation with an ordinary type screwdriver or any flat blade of proper width . . . the only modern screw engineered for Screwdriver Control.

Make your own test of CLUTCH HEAD'S *seven major features. You may do so by asking us to send you BY MAIL assortment of* CLUTCH HEAD *Screws, sample of the Type "A" Bit, and illustrated Brochure.*



CLUTCH HEAD Machine Screws are available in regular and thread-forming types...production backed by this organization and by responsible Licensees.

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This Type "A" Bit requires only a 60-second application of the end surface to a grinding wheel for full reconditioning to its original high efficiency.

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PLASTICS in PERSPECTIVE.....

"A ROSE by any other name . . ." True enough, but when should we use "plastic" and when "plastics"?

Life is simple enough when we talk about metals. There is no confusion, for example, when we write, "A knife made of steel," or "A steel knife." But we do become involved in the use of the word "plastic" because many products or materials are plastic in the dictionary sense of the word that are not made of plastics. And "contrarywise" many plastics materials or products are not necessarily plastic.

A reader of *"British Plastics,"* apparently both perplexed and a little tired of the pros and cons regarding the use of "plastics" both as a noun and an adjective, writes to the editor and proposes a really ingenious compromise.

Why not, he submits, use the word *plastix* as "singular or plural, as adjective or noun, to indicate the class of substances which we all now call plastic"?

What do *you* think?

•

RECENTLY, a potentially important customer asked a molder specializing in a certain product to prepare a line of samples. The customer intended to incorporate these in samples of his own product, of which the molder's specialty was a necessary component.

The question arose as to who should pay for the design. The end user said that he would survey his wares to see which of the molder's items was most popular, for which he would then place a substantial order. He therefore insisted that the molder assume the cost of the design.

But the molder maintained it was not his province to provide design—he was ready to produce whatever the customer wanted. If the latter had no design of his own, the molder was not the one to supply them. Everything he did outside of molding was an extra for which compensation was to be expected. Since the customer remained obdurate, the deal was off.

Similar situations are going to crop up frequently during the transition period to peace-time production. Now is a good time to think of what you would do when it confronts you. It is obvious some equitable solution, satisfactory to all concerned, can be found.

•

WHEN it comes to machines, the educated layman is no more critical than the man-in-the-street. He tends to think of them in abstractions—of the almighty machine rather than of a particular machine designed to accomplish a definite, limited result. As a consequence, he thinks the machine is perfect and can do no wrong. But anyone who knows anything about production is not that naive. He knows that a machine just produced is often subject to correction and modification until it attains top efficiency. And, this is especially true where a machine is designed for one purpose and subsequently adapted for another.

Such an evolution is manifest in many of the machines now being used in the plastics industry, as Gordon Sayre points out in this issue; and it is no carping spirit but rather in friendly criticism that he presents his views to our readers in the machine-building phase of our industry. Many molders have been silently nursing grievances against the machinery makers. In speaking for them, Mr. Sayre not only relieves their feelings but also informs the machinery men just where they may improve their product. His is constructive criticism, not mere muck-raking, for he does not speak vaguely. He tells just what shortcomings he finds and in what direction the remedies may possibly lie.

He shows how safety factors can be improved, how power can be economized, why molding plant layout must be taken into consideration in machine design. Such information should be helpful to the machine builder. He certainly does not want to deliver a product on which the molder must spend precious time and effort, improvising and changing, to achieve the desired results. That is not the molder's business and he doesn't want it to be his business.

We hope and believe that Mr. Sayre's article, emanating as it does from a plant which stands high in the regard of the trade, will do much to clarify the atmosphere and bring two great factors in the industry into closer cooperation. If the article helps achieve this, even in a small way, we will be happy in the knowledge that we played a "bit part" in sponsoring a progressive step in the advancement of the industry.

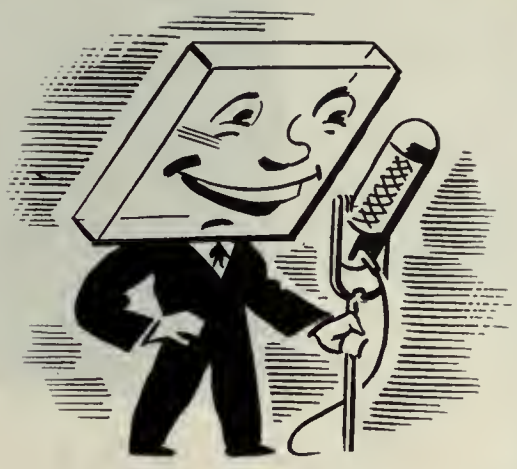
•

TWO months ago, in commenting on the Housewares Show held in New York, we pointed out that the furniture salesmen there knew nothing about the plastics used in their products, and we suggested it was about time that our industry developed an educational program in their behalf. For, we pointed out, if the people who were in direct contact with the buying public didn't know the elementary facts about plastics, they certainly could neither do an intelligent selling job, nor could they build up the confidence of the public itself in plastics consumer products. We are glad to report now that the Society of the Plastics Industry has been doing some intensive thinking on the subject and is on the way to achieving solid results.

To begin with, SPI conceived the idea of working on this project with the leading organization in the retailing field—the National Retail Dry Goods Association. As a result, they are embarked on a cooperative venture out of which will come a retailers' handbook of plastics, the exact contents of which are still in the process of formulation. But they will include a "capsule encyclopedia" of plastics, outlining the basic types and processes, the properties of each and the products for which it is suitable, the use of plastics in combination with other materials and fabric finishes and treatments.

Among other features, there will be material on sales training which will reach directly to the man or woman behind the counter. An interesting item is a proposed form the store buyer will fill-in concerning each plastics product and pass on to the salesperson who handles it. On this form the buyer will indicate the type of plastics of which the article is made, its desirable properties and the precautions to be taken in its use and maintenance.

If the handbook itself measures up to its prospectus (and we have no doubt that it will) the SPI—and the NRDGA—will have done a signal service which warrants the hearty endorsement of the entire industry. END



If PLASTICS could only talk—

If plastics could talk they would tell you, we think, that they enjoy being molded by Mack. As a matter of fact, we can let the plastics we have molded speak for us.

We will be glad to show you innumerable samples of all kinds of plastics, in all colors, molded in all shapes and sizes for many different industries. Of course, we will show you only our good pieces. We have made our share of mistakes. But most of them are rather far behind. They are your assurance that fewer mistakes will be made in the future, that your order will receive prompt, reliable attention. Mack Molding Company, Wayne, New Jersey; Arlington, Vermont; Waterloo, P. Q., Canada.

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Worth knowing

When you break the seal of a Tri-Sure Closure you *know* what is inside a drum. You know that no water, or dust, or any impurities have reached the contents. You know that every drop of material you ordered has been delivered—exactly the same quantity and quality that was put in the drum.

The reason is that Tri-Sure Closures seal a drum hermetically — with a seepage-proof, leak-proof seal, plug and flange. And that is the reason why more and more plastics manufacturers are insisting upon the delivery of all liquid material in drums that are equipped with Tri-Sure Closures. If it's worth *knowing* what you are getting when you buy material, specify "in Tri-Sure fitted drums" when you order any chemicals.

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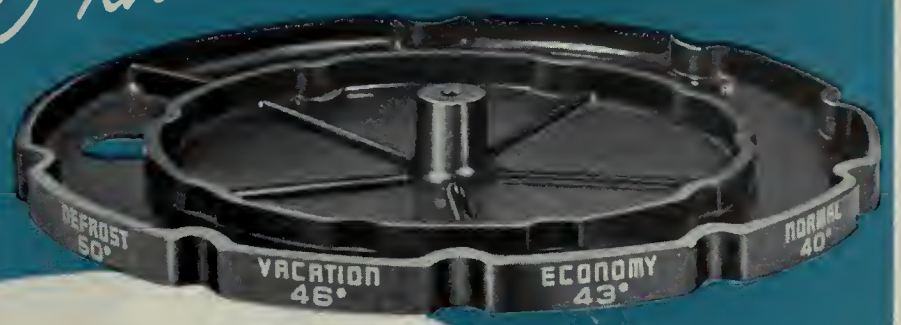
Special "know how" required



FOR JOBS LIKE THIS

Letters and figures on this plastic dial (for electric refrigerator temperature control) were included in the mold. This resulted in a substantial saving over the cost of machining them into the piece, after molding.

Such a method might seem to be simple and obvious, but it required much special skill. The correct plastic compound with the proper shrinkage had to be chosen. Then, the molds had to be designed so that the pieces could be removed without defacing the markings.

This special "know-how" is what we at General Industries offer you in our molded plastics division. Of course, we have all the machinery needed for large or small jobs in compression, transfer or injection molding. But in addition, we have that ingenuity, skill in mold making and willingness and ability to think through on a job before it is undertaken. In plastics molding, there is no substitute for experience.

If your postwar products call for plastic parts, we suggest you consult us before making definite commitments. While our engineers and facilities are now taxed to the limit with war work, we can discuss your requirements in general terms, and later get down to facts and figures. We'd like to work with you.

ARMY E NAVY

THE GENERAL INDUSTRIES COMPANY

MOLDED PLASTICS

Molded Plastics Division • Elyria, Ohio

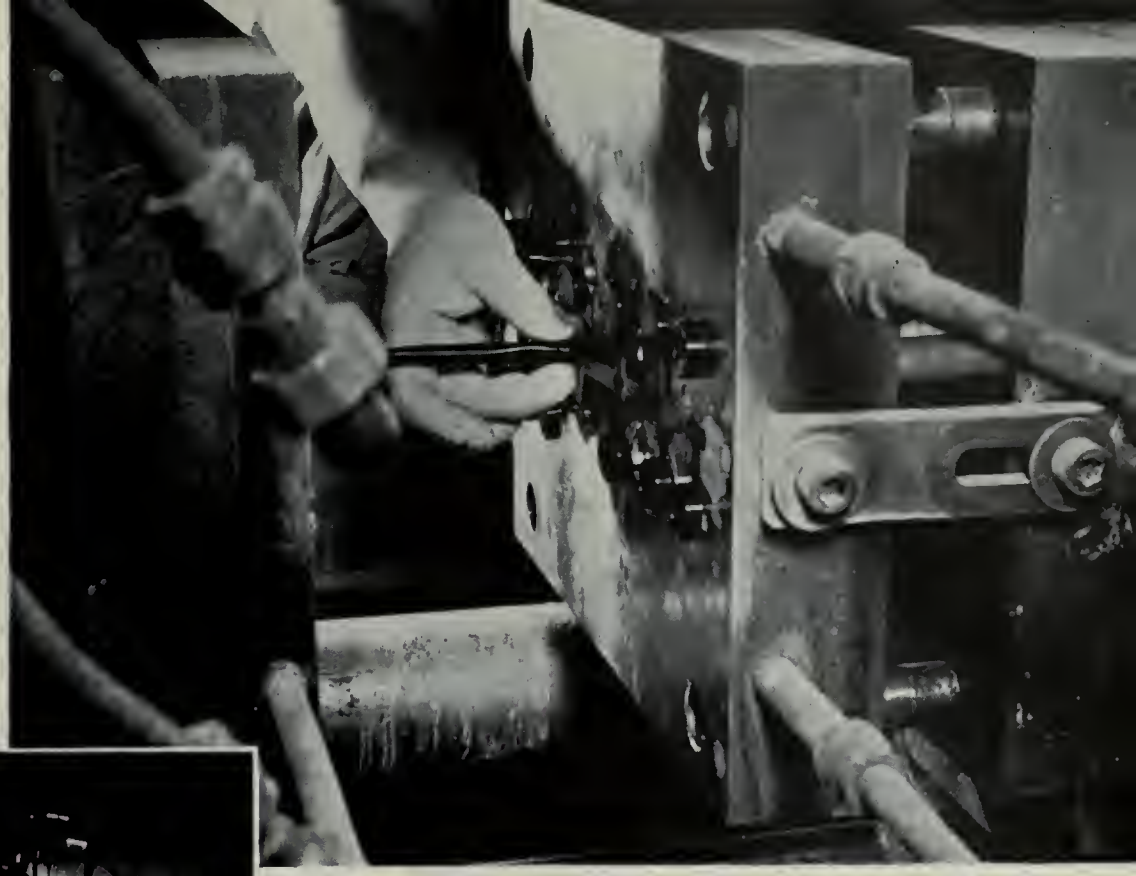
Chicago: Phono Central 8431
Detroit: Phone Madison 2146
Milwaukee: Phone Daly 6818
Philadelphia: Phone Camden 2215

Here's a picture of progress in plastic molding—significant of past achievements and sound planning for the future . . . You see above, a part of the Amos engineering and sales organization in Edinburgh—outside the new office building—with president Roy Amos turning the first shovel of earth on the day of ground breaking for the company's new plant.

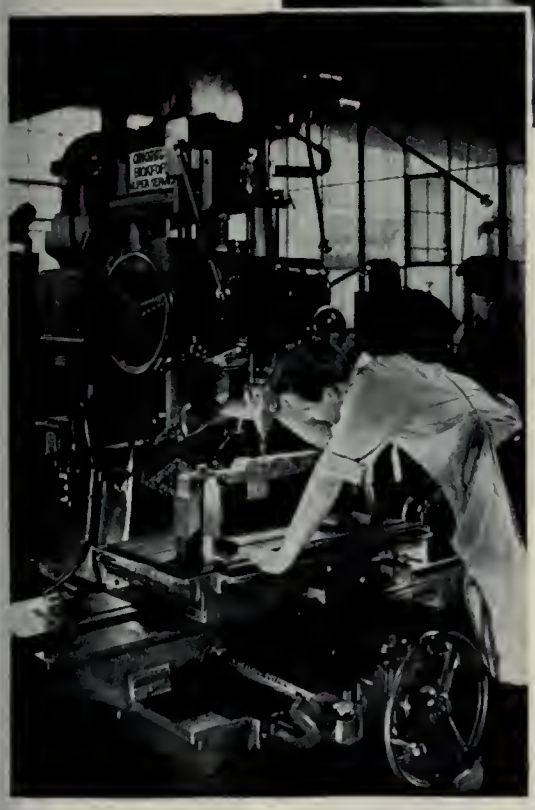
In the insert above is a miniature of the architect's drawing for the building that will greatly expand Amos facilities for molding plastics. This expansion was made possible by Amos customers—by the many companies that like the way Amos designs and produces custom molded plastic parts and products to meet their needs.

From engineering to finishing, customers say: "Amos does a complete job—and does it right." You'll say that, too, when Amos does a job for you . . . Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation



Right, removing group of thermoplastics parts from multi-cavity injection mold. Below, jig borer, equipped with micrometric dials, used in precision mold construction to reduce setup time



YOUR *Molder* CAN HELP YOU

By J. W. Stokes
Chicago Molded Products Corp.

Skill, Equipment and Knowledge of Custom Molders Are Invaluable to the End-User

"WHAT is the place of the custom molder in the plastics industry today?"

This is a question which has been asked by many end-users of plastics products and parts, particularly those who are now planning resumption of pre-war or civilian operations immediately after the war.

The custom molder may be described as the link between the manufacturer of molding materials and the manufacturer who uses plastics parts in his products. Upon the molder's engineering skill and productive ability may hinge the success or failure of a drive for markets in the post-war world.

A molder is more than the producer of your product: he is a consultant as well. If you want to produce 1,000 or 100,000 toy automobiles or switch boxes or radio cabinets, he can design and construct a mold that will stand up. He can recommend and supply to you the one plastics from among the myriad that may be available which is most economical and yet most suited to your needs.

There are a few manufacturers who have been doing their own plastics molding, and it is possible that there will be some increase in this practice when peace comes and equipment is again readily available. Most manufacturers, however, will find it highly impractical for a number of reasons:

First among these is the wide range of equipment necessary for even the everyday requirements of the average

Above, phenolic bomb-booster mold on compression press. Note preforms on mold. Below, removing finished part from press

user of plastics. A well-equipped molding shop should have a complete set of molding presses of every type and size so that each part will get the handling called for by its design, instead of by the equipment which happens to be available at the moment. A plastics molding job must be planned around the requirements of the piece to be produced rather than the particular presses the company may happen to possess. Therefore, many of the largest manufacturers in the country depend wholly on the custom molder for their plastics parts. Even the few manufacturers having large molding departments of their own frequently place work with custom molders.

The well-equipped custom molder will have a series of injection presses, ranging in capacity from 2 oz to at least 8 oz, and compression presses ranging from 50 tons pressure or less to at least 500 tons, and possibly more. Obviously, there are few manufacturers indeed who could justify the maintenance of anything approaching such a range. The custom molder, however, must have it to take care of the widely varying needs of his customers, and can, therefore, produce each job by the best and most economical method.

How Molder Can Help

But there are many other ways in which your molder can help you with your production problems in plastics.

He can, to begin with, advise your engineer regarding the proper designing of your product. Every molder has had the experience of receiving a design which is either impossible to work from or which will result in a mediocre job. No molder wants to turn out mediocre work, if for no other reason than that he is interested in building up long runs and his customer's success means his own success.

The experienced molder will see at a glance whether or not a proposed design will work. This is a skill which comes from actual molding experience with design problems involving such items as undercuts, sidewall drafts, tolerances, fillets, webs, ribs, letters, holes, threads, inserts, assembly and many others. Unless there is thorough understanding of all these phases of plastics molding design, difficulties may develop.

The molder has this knowledge, and often by suggesting changes which will avoid designing pitfalls, he can help your engineer create practical and economical designs. Frequently, a manufacturer working out a new product in plastics will find that his most perplexing problem can be cleared up merely by calling in his molder for a brief consultation.

Molding is a highly technical and specialized process and it is no wonder that many engineers lack sufficient knowledge of molding materials and fabrication technique to work out economical and practical designs independently.

For example, one of the most important things to consider in the design of any part is the *bulk factor*. Most molding material comes to the molder in powder form about as coarse as granulated sugar. It may then be put in a die in this powder form or preformed into pellets or special shapes required by the die. If it is used in powder form, the material will take up a minimum of two and a half times its final volume. Where coarser materials are used, the bulk factor will go considerably higher, as in the case of some canvas base materials where it may reach 8:1. Even if the material is preformed, the bulk ratio will still be approximately 1.375:1.

The designer must know of what material the part is to be made and the form in which this material will be used, before he can plan his mold. Otherwise, he may find himself with an excellent mold except for the single fault that it cannot be used. There are a great many other

tricks of design which may mean the difference between a good and a poor molded part.

The molder knows whether a pin will bend or snap if a mold is attempted having a hole of less than 1/16" in diameter and over 2½ times the diameter in length. Experience has shown that a length to diameter ratio of these proportions in a hole this narrow is not sound.

Does your design call for a side hole? The molder will advise you to turn it into a slot opening to the top or bottom if you possibly can. Your mold will be greatly simplified.

How close a tolerance must you have? Very close tolerances are obtainable—if you are willing to pay the inspection and scrap costs. Standard commercial tolerance on products of average size is ±.005"; if you want tolerances less than ±.002" or ±.003" you will run into additional time and cost factors.

Will your molded part have to be machined? Perhaps it can be so designed as to avoid the necessity of expensive machining operations. Take the matter of threading: In many cases it is more practical to mold the thread rather than mold a straight hole and then tap the thread. This is particularly true where the diameter of the hole is greater than ⅛" and the thread gets frequent usage.

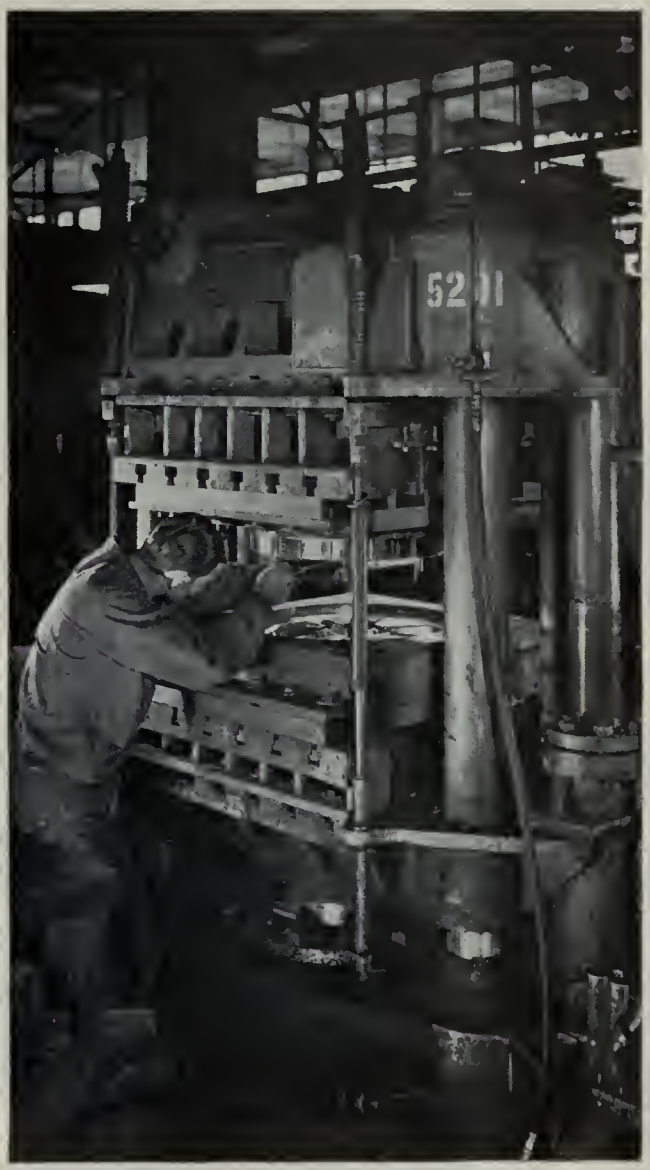
The question often arises, "How cheap a mold can I get?" As a general rule, it may be said that this is one of those instances where economy does not pay. The type of mold you get must depend for the most part on the work you have in mind for it. If you intend to do a very short run of ash trays, for example, a cheap job may be sufficient. Beyond that, you will be taking a losing chance. A cheap die will wear out quickly, lose shape and break down completely just when you are getting into the heaviest part of your run.

A die takes a tremendous amount of punishment during the molding process. It may be subjected to heat as high as 400° F and to pressure running up to 30,000 psi. Thus, the necessity of using the strongest and most unyielding metals in a mold becomes apparent.

There are dozens of metals and alloys which might be used. Beryllium copper has been used frequently with fair results, but it is undesirable where close tolerances or a polished molded part finish are needed. Steel is generally preferred for most purposes, and in choosing the particular type of steel to be used, such characteristics as cleanness, uniformity, machinability, strength, heat-treating, safety, hobability, toughness and good finishing qualities must be considered. Selecting a correct metal for your mold can assure close tolerances and fits as well as polished finishes. The last is important because it may greatly simplify the task of removing the part from the mold.

Tool Room Facilities

It is also advisable when selecting a molder to choose one who can offer tool room assistance as well as molding facilities. The reason for this is that a tool shop will often construct a mold which the molder insists cannot be used to fabricate your proposed product. The tool shop is just as insistent that it has followed the design implicitly. Who is to blame—the toolmaker, molder or designer? The molder who has the facilities for handling the entire job and who is given the entire job to do, is charged with the duty of sweating through all the engineering problems, checking through the multitude of plastics materials for the one which best answers these problems, constructing the mold, running the job, finishing each part and feeding it into your production lines in accordance with your schedule demands. In such a case, there cannot be any question as to where the responsibility lies.



Above, loading 7 inserts in mold for general-purpose phenolic "Cardineer" card index wheel. Below, a closeup of wheel mold

This fixture makes possible the simultaneous loading of eight transfer mold cavities used in producing the M-52 fuze body

Due to complex coring and threading in M-52 fuze body, each cavity must be dismantled to remove body, then re-assembled

Halves of a simple injection mold for "Lumarith" putty knife

One of the most important services performed by the molder is the selection of the material best suited to your needs. Many manufacturers make the error of deciding upon a specific material simply because a neighbor or competitor is using it, or because it proved satisfactory in the past. Developments are occurring so rapidly in the entire industry that it is good business to check with the molder on every job on the chance that a material has come to his attention which might cut costs or otherwise improve your product.

It has been demonstrated many times that plastics are superior, under many conditions, to other materials. Frequently, plastics in combination with one or more other materials may prove to be the best substance of which your product may be made. The selection of the plastics which can come closest to satisfying all your needs is no easy matter. A good deal of experience gained through the handling of a great many molding jobs—from the hard-to-handle, high-impact, thermosetting plastics to the colorful thermoplastics—is necessary.

Almost every plastics material has one or more uses for which it is best suited. Thus, the ureas are excellent for eye appeal. Available in all the interest-compelling colors of the rainbow, they command attention and may be used for almost any item calling for beauty. Phenolics, on the other hand, lack the urea's wide range of colorability but make up for this limitation with such characteristics as strength, economy and moldability. And if you are seeking a material which can replace wood or marble in counters, tabletops, etc., laminated phenolics are often the answer.

Every production requirement, every sales argument enters into the selection of the proper plastics. In addition, all of the properties of the materials under consideration have to be examined. Such mechanical and physical attributes as specific gravity, hardness, modulus of elasticity, refractive index; tensile, compressive, flexural and impact strengths; machining qualities and color enter the picture. The thermal properties of the material, such as specific heat, thermal conductivity and expansion, heat distortion and continuous resistance to heat must be considered. Volume resistivity and dielectric strength, as well as such other electrical characteristics as arc resistance and power factor; chemical properties, moisture absorption, flammability, burning rate and the effect of aging and weathering all help determine the best plastic for your product.

Choosing the Right Material

The selection of the plastic most suited to your needs is far from simple. In view of the number of plastics which have already been developed and the many characteristics which must be tested, the need for an expert to advise the end-user is obvious. The molder, because his primary interest is to develop long runs, is best fitted to give unbiased advice as to the proper plastics to be used.

Still another way in which a molder can assist is by suggesting the most efficient and economical method of molding a product. There are several different processes which may be used, depending on such factors as material, cost and the shape of the molded part.

The oldest, and probably most widely used plastic molding process is the compression method, in which the material is loaded directly into the cavity of the open mold. This method is used for both thermosetting and thermoplastic materials. Since in the latter the mold must be alternately heated to cause the material to flow, and then chilled to harden, the cycle is slow, with costs correspondingly high. Therefore, in actual commercial practice, compression molding is used only for those thermoplastics

(*Continued on page* 112)

Tips for these 120 pencils are Injection-molded of Tenite in one casting

● Brightly colored Tenite pencil tips are scheduled for postwar use. Colors available in Tenite are unlimited, and the plastic is eminently suited to modern, streamlined design. In serviceability, Tenite successfully competes with metals traditionally used for pencil ferrules. Thin-walled and resilient, the ferrules grip both pencil and eraser without splitting.

The use of Tenite plastic effects economies in material and manufacturing operations. Because it is exceptionally light in weight, the plastic yield is greater than that of metal. Tenite castings are injected at the fastest speeds ever attained with plastics, and no costly finishing operations are required.

Tenite is extremely well-adapted to the mass production of small parts and has long been used for radio knobs, automobile interior appointments, refrigerator parts. For more information, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

TENITE *an Eastman Plastic*

Tenite pencil ferrules molded by Essex Corporation

Developing Jigs for Plastics Fabrication

A bead-drilling jig. The three lower prongs permit reception of work before operation, ejection of finished bead with new blank

By Mel Meyers

Simplicity and Ingenuity Are Required in These Special Aids Which Cut Production Time, Costs

FABRICATORS of plastics tend to be secretive about the jigs they devise for production work. These devices seem to be guarded almost as jealously as a formula by manufacturers. This attitude is understandable, since, in a sense, each newly designed jig is an invention in itself, contrived for a specific operation on a specific piece. The mechanical operations on a plastics item remain basically unchanged (sawing, drilling, sanding, etc.), but the design of the piece changes in dimensions, contour and other characteristics from one item or part to another.

Each new jig, therefore, is a new conception. There are, of course, fundamental principles in jig design as in most processes, but, except for a few common standard jig forms, an individual jig is unique.

The ingenuity involved in the designing of even some of the simple jigs is something that frequently goes unrecognized by the marketer or end-user of fabricated plastics items, who knows his market and knows the design that will sell the market, but who knows comparatively little about the processes involved in the execution of his design. And yet the jig enters directly into the determination of the cost of manufacture of his design. When a plastics fabricator bills his customer for the cost (almost entirely time-labor cost) of a jig, the bill is not for an item above and beyond the per-piece cost of the article so much as it is a bill for a device to reduce the cost of manufacture and, ultimately, the cost to the marketer. Very often the cost of the jig will not appear on the bill at all, but will be absorbed into the cost of production. That happens especially where the production run is a large one and where the cost of making the jig is a small fraction of the overall cost of the job.

The hitherto accepted distinction between a jig and a fixture has been this: A jig is a device that guides the work to the tool or the tool to the work; a fixture is a device that supports the work. In the plastics fabricating industry, as in some other fields, this distinction has been fading to the point where "jig" is the term currently used to cover both types of devices. Even in assembly operations where the device is in a purely holding function, such as cementing jobs, the word "jig" (specifically, "assembly jig") is in current use.

In this discussion the word is used in the dual sense. However, a functional distinction between types of jigs may still be made, on the basis of the relation of the jig to the method of feed, between the mobile or riding jig and the fixed jig. For instance, the angle-cutting and ball-splitting jigs of Figs. 1b and 2b, respectively, are mobile jigs that ride the work to the tool. The tool is stationary; that is, it is operative at one point; both the jig and the work are in motion.

The bead-drilling jig shown above is a fixed jig that supports and positions the work. Here the jig is stationary, the work is stationary, the tool in motion. Still another variation in jig function is to be seen in the button-drilling jig of Fig. 3b, where a fixed jig supports and guides the riding work. In this case, the jig is stationary, the tool is stationary and the work is in motion.

The design of the work and the operating characteristics of the tool are not the only prime determinants of jig design. Efficiency of feed is at least an equally important consideration, for the jig is essentially a device for operations involving hand-controlled feed, whether the work is fed to the tool or the tool to the work. This holds true not only for small-parts machine operations, with which this discussion is concerned, but also of operations on work of large dimensions. It applies as much to the huge trunnion jigs for operations on large-surfaced airplane body and car body parts as to the small drill jig of Fig. 1c.

Fig. 1a. Scribed indications of operations to be performed in angle-cutting acrylic blank. Circles indicate drill holes

Where the feed is not hand-controlled, but is automatic, any device that controls the feed, whether called a jig or not, is in reality part of the machine itself.

Over and above any general rules for jig design that can be laid down, there is one principle that the jig designer adheres to: The jig must be the simplest possible one for the operation to be performed. That sounds easier than it is. A simple jig is not always a simple matter. Often the most obvious jig design for a given application is a complicated one and it will take time, thought and ingenuity, in addition to experience, to reduce it to its simplest operable form. When a jig designer is aiming for simplicity, it is not the time and cost of making the jig that is in his mind so much as the fact that the simpler the jig, the greater the facility with which the operator can work with it and the smaller the degree of lost motion and, in the end, the more rapid the operation and the lower the production cost per piece.

In recent years there has been an increasing tendency to utilize plastics materials for the making of the jigs themselves, a procedure that is especially appropriate in the case of plastics fabricators, since the material for the plastics jig is at hand and is usually available from scrap.

While metal is a requisite for jigs applied to operations where close tolerance is a factor, for jigs which have acutely-angled impact-sensitive points and for many other jig structures, plastics can frequently replace metal and are preferable in many instances. This holds true to an even greater extent in comparison with wood. Plastics jigs are made with no more difficulty than wood jigs and with greater ease than those of metal. As compared with jigs of the softer woods, the kind of woods most likely to be available around the plant, the plastics jig is non-splintering, more durable and rather less affected by impacts in use. Jig qualities similar to those in plastics jigs are attainable in maple and other hard woods, but the wood jig is no more easily machined and it has the disadvantage of being, as far as a plastics fabricating plant is concerned, a less available material than the ubiquitous plastics scrap.

In a discussion with William Pike, vice president in charge of production of the Ply-Tex Manufacturing Co., New York City, where plastics jigs have been used fairly extensively, two particular advantages of jigs of this material came up: Since, unlike wood and metal, plastics are available in different colors and shades, they make it possible to design the jig in a color that contrasts with the work. In continuous hand-fed operation in large production runs, this is a more significant thing than it would appear at first thought. It is comparable to color contrasts in other fields involving machine operation. It has been only during the last few years that attention has been given to functional differentiation of machine parts through color contrast for operational safety purposes.

To a lesser extent, color contrast has been applied to differentiation of controls where several controls on a single machine are periodically manipulated by a single

Fig. 1b. In positioning the jig and work for the second angle-cut, the work need not be lifted from the saw table

Fig. 1c. The blank is shown here positioned in a jig designed for drilling a hole located in the remote corner

Fig. 1d. Of two sets of three holes to be drilled, all but one hole has been completed. Work is in position for final drilling

Fig. 2a. Jig for splitting acrylic ball. Spring pressure on ball relieved by lever in right hand; ball dropped in place

Fig. 2b. A circular saw cut splits the ball. Note the released lever at right and returned spring-pin in foreground

Fig. 2c. Result of the operation pictured in two top photos is illustrated by original blank (above) and halves (below)

operator. The application of color contrast between jig and work has received almost no application at all, in spite of the fact that the psychological principle involved would seem obvious enough. In any operation where attention in manipulation is required, the eye is in play; and *whatever aids the eye aids the hand.* On the principle that whatever eases the attention requirement minimizes operator fatigue, the use of color contrast between jig and work becomes an efficiency factor. Plastics for jigs provide the opportunity for taking advantage of this as no other materials do.

The second point of superiority of the plastics jig appears in water-cooled machine operations—those operations in which water or solutions in water are used as coolant on the work at the point of operation. An obvious example of this is a circular saw taking a smooth fast cut in a thermoplastic material. A jig of wood, continually subjected to the water, tends to swell and, therefore, to be thrown out of true. A steel jig will rust unless carefully dried periodically. A plastics jig will do neither.

To exemplify these two qualities of the plastics jig, the cooperation of Mr. Pike was enlisted. He was presented with a purely arbitrary design for an acrylic part requiring two machine operations and he agreed to design the necessary jigs in plastics materials. The design of the piece and the operations required on it are shown on the blank in Fig. 1a.

It can be seen that at each corner of the blank there are to be two angle cuts, each at a different angle. The intention here was to make it possible to take both angle-cuts for each corner on the entire run without changing the position of the gate. The jig of Fig. 1b accomplishes this. Since the guiding edges of the jig for the two required angles are contiguous, only a small turn is necessary to set the jig against the gate in order to switch from one angle to the other. The containing notch is of such dimensions as to take a mildly snug hold on the work, so that insertion and removal of the blank are facilitated. The jig is made of black cellulose acetate and forms a perfect eye-easing contrast with the acrylic work. In addition, if a water coolant were needed, which happens not to be the case in this example, rust on the jig is obviated and warping from moisture absorption is held to a minimum compared with wood.

If the jig were made of thicker stock, it could take a lay of several blanks for each cut. This would hold true only within limits, however. For one thing, since the fit of blank in jig-notch must be fairly snug for the cut to run to required dimensions, the number of blanks that could be inserted and removed with ease would be limited. In addition, a compromise in the thickness of the stack has to be struck in relation to the character of the cut (rough or smooth), the tooth distribution of the blade, the thickness of the blade and the operating speed. The compromise in the height of the stack of blanks will determine the thickness of the jig.

The acrylic piece as it stands after the saw operations have been finished (Fig. 1c) becomes the blank for the drilling operations. Fig. 1a shows that there is to be a set of three holes at each end. While these holes are symmetrically positioned for either end of the piece, there is no symmetry in the relation of the three holes to each other—that is, in no case is the distance between any two holes in the group the same as between any other two. The jig had to conform to this asymmetrical arrangement. The three stops for the three different required positions of the blank under the drill are placed accordingly. It is to be noted that the design of the stops themselves has been kept simple. The stop in the foreground of Fig. 1c, the one that accepts the entire conformation of the end-

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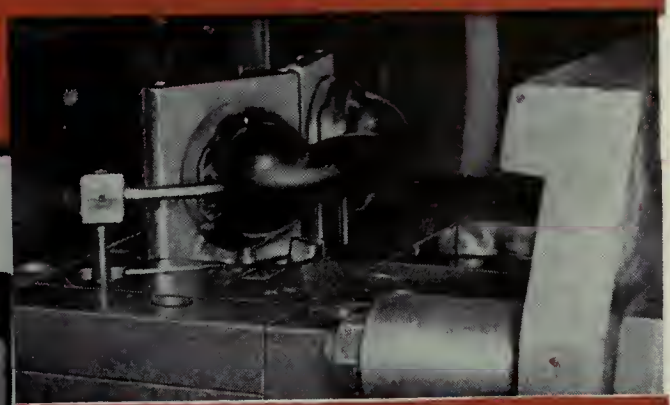

▲ *The molded handset ready for ejection from the mold after the 30 second perfect cure.*

◀ *Megatherm heated preforms in press transfer chamber just before closing.*

Photos Courtesy Shaw Insulator Co.

Federal Industrial Power Tubes, give power and performance to Megatherm and other industrial heating equipment.

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Fig. 3a. An acrylic button with a sewing-thread hole drilled in nipple or self-shank by special jigging shown below

Fig. 3b. Jig channel conforms to cross-section of button's self-shank. Clamp at right holds jig down and acts as stop

Fig. 3c. The button, its self-shank tracking in the channel, rides on the jig to the drill and then backs away

corner of the blank, is positioned for drilling the remote center hole.

This same conforming design might have been used for the other two stops also. This was avoided, and maneuvering of the work on the base of the jig was facilitated by using a simpler stop that operates in conjunction with the first, as seen in Fig. 1d. The two together act as a single unit to form the positioning guide for a side hole. For the double purpose of keeping the stops brightly visible against the jig base and of contrasting both elements of the jig, base and stops, with the work, the base was made of brown stock and the stops of red, all phenolic.

Mr. Pike in finishing the jigs kept in mind a point that is not often considered: The feel of the jig in the hand of the operator. That may seem a small point, but it assumes importance as an operator fatigue (and efficiency) factor where the jig is used in long runs. In both jigs, all edges that contact the fingers of the operator have been beveled and sanded smooth.

Several jigs were supplied for this discussion by A. D. Seidman and Ben Breslow of the Ace Plastic Novelty Corp., Brooklyn.

In the ball-splitting operation to be performed with the result shown in Fig. 2c, once the machine, a small water-cooled circular saw, is decided upon, the problems involved in the feed and determining the design of the jig may be analyzed as follows: 1. The acrylic ball must be held firmly to prevent aberration of the work as the saw-blade passes through; this means that there must be clamping or pressure action on the ball. 2. The ball must be fed easily and rapidly. 3. The ball should be ejected rather than lifted out. And, as for any mobile jig, the guide must be true and the stop point must be as close to the end of the operation as possible to avoid lost motion and complications in jig structure.

Problem No. 1, firm hold, was solved by designing the ball-reception chamber to conform with the contour of the blank and by applying internal spring pressure to "mate" the ball with the chamber. In the solution of Problem No. 2, insertion of the work (see Fig. 2a), the jig structure is arranged to permit dropping of the ball into the reception chamber. For this purpose, the internal spring is contracted by pulling back the small lever with the right hand, the ball is slid or dropped in with the left and the lever is released to permit the spring to press against the ball. After the splitting operation, shown in progress in Fig. 2b, and retraction of jig and split ball from the saw blade, the lever is pulled back again and the ball-halves drop into a bin beneath the working plate, thus solving Problem No. 3. The next blank is inserted with the lever still pulled back for the previous ejection.

The photo on page 26 shows an acrylic ball-bead job, obviously a drilling operation. Analysis of the problems of feed in this case shows the following: 1. The ball must be held to prevent aberration during the drilling process. 2. The ball must be fed easily and quickly. 3. The ball must be ejected rather than taken out.

The small steel jig for the bead-drilling operation has a simplicity that belies its ingenuity. In the first place, shaping of the jig to the ball contour is avoided altogether. It is the angles of the three prongs that determine the positioning of the ball under the vertically-operated drill. Second, the ball is merely slipped into the prong-formed crater. Third, and most interesting from the viewpoint of efficiency, the feeding of a blank automatically ejects the finished piece: that is, as the drill recedes, the drilled ball is simply pushed out by the ball being fed in. The operator holds as many blanks as three fingers closed against her palm will permit, slides these up one after another to her thumb and forefinger, which place the ball

Fig. 4a. The crater in the spindle-end of this bolt-inserting jig conforms to the bolt-head, into which insert fits loosely

Fig. 4b. Bolt threads engage plastics handle; then bolt head applied to revolving jig insert until bolt is snugly in handle

in the jig. Her mere placing of the blank in the jig pushes off the drilled bead. We have here a manual feeding-and-ejection operation that is perhaps as nearly automatic as hand-feed can be—so much so that the whole operation can become purely cyclic by changing the foot-pedal control of the vertical drill travel to an automatic travel, so that the drill comes in and withdraws at a definite frequency consonant with the normal feed rate of the operator.

The half of this drill jig that has the downward-pointing prongs travels with the drill until the prongs engage the ball. There they stay to cooperate with the lower prongs in holding the ball while the drill comes in to do its work. As the drill withdraws, a small spring operates to return the upper set of prongs to the position from which they started.

An excellent example of an operation in which a plastics jig is superior to one of wood and at the same time takes less time and cost to make than a metal one is the jig shown in Fig. 3b for drilling a sewing thread hole in an acrylic coat button. The machine used for the operation is a horizontally-operating drill in a Jacobs chuck at the end of a simple belt-driven high-speed spindle. The work is manually fed to and withdrawn from the drill in a lateral motion.

The problem here was primarily one of guide. Since the flat side of the button provided a natural rest surface for the work, it was just as natural that this flat side should travel along the jig surface. The problem narrowed down to the nipple on the button—known in the button trade as the "self-shank". The obvious solution was to sink a channel below the jig surface to contain the self-shank. The cross-section of the channel had to conform to the contour of the self-shank (Fig. 3c shows that it does).

An interesting sidelight on this jig is the fact that the clamp that holds it down at the right in Fig. 3b acts as the stop, so that, beyond its holding function, the clamp becomes in effect an integral part of the jig. The operator places the button on the jig flat side down with the self-shank in the channel, slides the button up to the stop (the drill going through the shank on the way), backs the button away until it reaches the left end of the channel and drops it off into a bin. Incidentally, this jig, made of a black phenolic, presents another example of color contrast between jig and work.

Figure 4a shows a jig which is involved not in a machine operation that fabricates the material to design, but in an assembly operation extrinsic to the design. Although, in actual use, the bolts function with the handle, in fabrication the bolts have nothing to do with the design. In fact, the bolts do not belong *in* the handle at all, since they will be removed before use. However, the handle is to be marketed with the bolts inserted and the customer wants the handle ready for market. In effect, the bolt-insertion operation becomes purely a merchandising aid. The fact remains, however, that the operation is a factor in completion of the item before shipment, that time-labor is involved and that this time-labor is a unit, even if a comparatively small one, of the cost of production.

The bolt-insertion jig comes into play after the operator, by a single turn by hand, has given the thread of the bolt a preparatory hold on the tap in the handle. A single movement, application of the bolt-head to the jig, completes the operation. The jig consists of no more than a bushing around a spindle-driven rod. The end of the rod facing the operator is the whole story. This end is hollowed or cratered to conform to the round head of the bolt. Across the middle of the crater is a thin ridge or insert that loosely fits the slot in the bolt-head. The engaging edge of this insert is so angled and beveled that, as soon as the bolt is home in the handle, the bolt-head slot slips off the revolving insert and can not be re-engaged by it. The bolt will go into the handle only up to the point where the fit in the handle tap is a snug-easy one and no farther, so that there will be no difficulty later in unscrewing bolt from handle.

There are many operations in which the jig may be rendered unnecessary by a tool especially designed for the desired result. For instance, in connection with the design of Fig. 1d, the jig can be eliminated and the saw operation canceled out by designing a blanking cutter that will punch out the whole blank to dimension and contour. Even taking into consideration the additional operation of warming the material to receive the blanking cut, this procedure would be a more efficient and economical one than the one of feeding to a saw by jig. However, where there is an alternative between a jig and a special tool for an operation on a given design, the selection has to be on the basis of the economics of the job. A very long production run might justify the design, execution, time and cost of a special tool. A medium run might not. A comparatively short run, as a rule, would not. END

Above, metol-plated items: Left to right, door handle, salad fork, automobile door handle perfume bottle closure, earrings and pins. Left, buttons, earrings before and after plating

The Future of Plated Plastics

By Raymond R. Dickey

Plating Will Enable the Plastics Industry to Satisfy The Post-War Consumer's Demand for Return of Metals

Buttons are placed into a centrifugal type of machine for application of clear lacquer coat

FROM novelty decorations and bright baubles to the field of precision instruments for industry is a long jump, but it is a jump that has been made with considerable success by metal-plated plastics since the outbreak of the war.

Plating on non-conductive surfaces has intrigued the electro-chemist almost from the origin of commercial plating methods. However, it has only been in recent years that production and precision plating on non-conductive surfaces has reached its present degree of success. It was quite natural that, of all the non-conductors, plastics would be those most feasible to plate. The ease of molding plastics to complicated shapes is a valuable asset. By plating, the manufacturer creates a metallic article which could not be achieved in mass production with a metal base.

To predict the future of plated plastics requires more than guesswork and crystal gazing. Some survey of past trends must be made. The history of metal plating on plastics has followed very closely the history of plastics molding, which found its first big volume market in the premium and novelty field. Thus it has been that the initial sales of plated plastics were largely in ornamental wares such as buttons, clips and all types of novelty jewelry. With new techniques and improvements in the plating process this field will offer even more opportunities than it has before. This is especially true where only partial or pattern plating is desired so that the effect of contrast between the colorful plastics and the lustrous metal can be

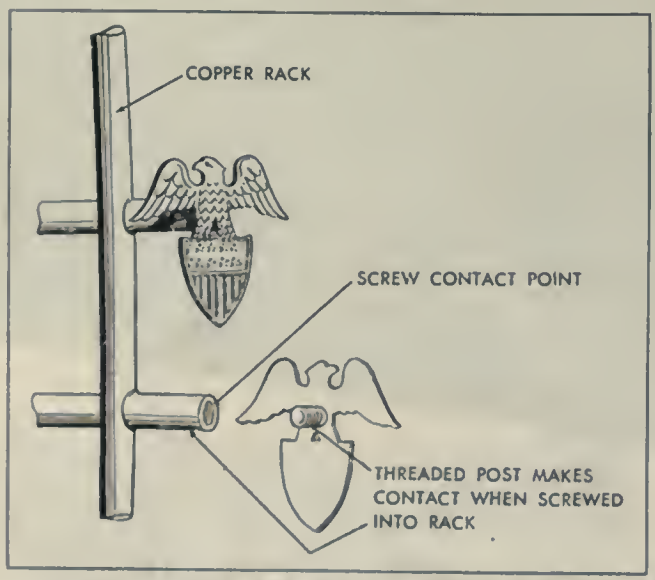
AMPHENOL for tomorrow's parts

Starting with plastics years ago, back in their early stages, Amphenol has kept pace with every step forward in molding—has participated in the development of new methods and processes. War's demands speeded progress. Amphenol ranks with the leaders—in plastic production and in capacity to produce.

Industry, now plastic-minded, finds here a source of supply for plastic parts—particularly those of more elaborate design and in large quantities. Batteries of injection and compression molding, and extrusion machines guarantee Amphenol's ability to produce in any quantities.

Operator about to place a jar filled with conductive bonding solution on rollers to insure uniform coating

Naval officer's hat insignia screwed on rack (also shown in drawing below) before being dipped in plating bath



Close-up drawing of the special rack (also shown in photo at right, above) which was designed to insure positive electrical contact with the Naval officers' hat insignia during the electroplating process. Continuity is tested before immersion

Naval hat insignia before and after plating over cellulose acetate. Eagle and standard are silver; anchors are gold

obtained in a variety of useful and decorative items.

As this civilian market started to develop, war came and with it the restrictions on metals and on plastics. Metal plating of plastics was harnessed to war production. Again metal-plated plastics followed a close parallel to their base material in that one of the largest markets was found in electronic and electrical equipment. Engineers wanted integral units which were electrically conductive on one side and excellent insulators on another. Here metal-plated plastics moved in, saving precious man-hours and machine time on such things as delicate commutators, barometric instruments, tube bases and in many other vital spots of communication equipment which cannot be revealed until after the war.

Metal-plated plastics are measurably stronger than unplated plastics. Tests in Table 1, (see page 102) showing this clearly, were made by an independent testing laboratory.

One of the most interesting applications of metal-plated plastics to a war job is the metal-plated plastics-plywood antenna mast used in high-speed fighting planes. This mast is plated with an extremely thick copper coating in large automatic plating tanks. Adhesion of the plate to the mast is an extremely important factor since vibration on high-speed aircraft is great and wind velocities are extremely high. Reports from all battlefronts indicate that this development is a definite success.

The wartime applications of metal-plated plastics indicate what the future holds in this field. Naturally, much depends on the type and size of equipment. Production technique and methods of engineering are also important factors which must be given constant consideration. For example, on the Naval hat insignia of G. Hirsch Sons, Inc., plated by the Monroe Auto Equipment Co., it was found that a considerable amount of time and labor could be saved by designing racks into which the threaded attaching post of this insignia would screw (see drawing). Previously, contact had been obtained on this insignia by wrapping copper wire on the post which failed to give positive contact in all cases, and in many instances came off because of the agitation of the plating solution during the time in which it was in the bath. It has been estimated that the design of this seemingly simple rack saved 15% of the time formerly spent on the job and gave a more satisfactory end product. It is in little things like this that future production of large quantity metal plating on plastics may depend.

(*Continued on page* 102)

G NAVAL OFFICERS' INSIGNIA AT METAPLAST CO. BRINGS OUT GLOSS OF GOLD AND SILVER METAL-PLATED PLASTICS

e toilet articles illustrate the design
il and full relief achieved through
new improvement made by
loid in injection-molding process.

Molding Intricate Designs

New Process Improves Detail in Ornamentation of Merchandise

A PROCESS which makes it possible to capture the full beauty of minutely-detailed designs in the ornamentation of injection-molded plastics products has been developed by the Gemloid Corp., New York.

The toilet set shown at the left bears designs molded in high relief. Other similar sets have been produced by Gemloid ornamented with designs having even greater detail. The themes employed are often taken from old brocades, which, in turn, may be derived from classic paintings and other sources, usually presenting a difficult problem in clear duplication of the original lines.

Engraving Process

The problem of separating the fine lines of the design in order to reproduce it in all its original clarity is tackled first by casting the design in soft brass on a scale several times larger than that of the final die. Then a mechanical engraving machine, employing a geared-down, remote-reproducing stylus-like instrument, is used to transfer the soft brass mold to a smaller die of hard brass. Extreme care must be taken at all times to eliminate any burrs from the surface of either die.

Molding the Designs

In the mold, the small die is fitted to very close tolerances in order to avoid flash. Usually it is bolted in place, but it may also be mounted on a block to groove into a cutout on the mold.

When the body of the mirror, brush or other unit emerges from the mold, the design is cleanly impressed in full relief into its surface, and requires no further mechanical treatment.

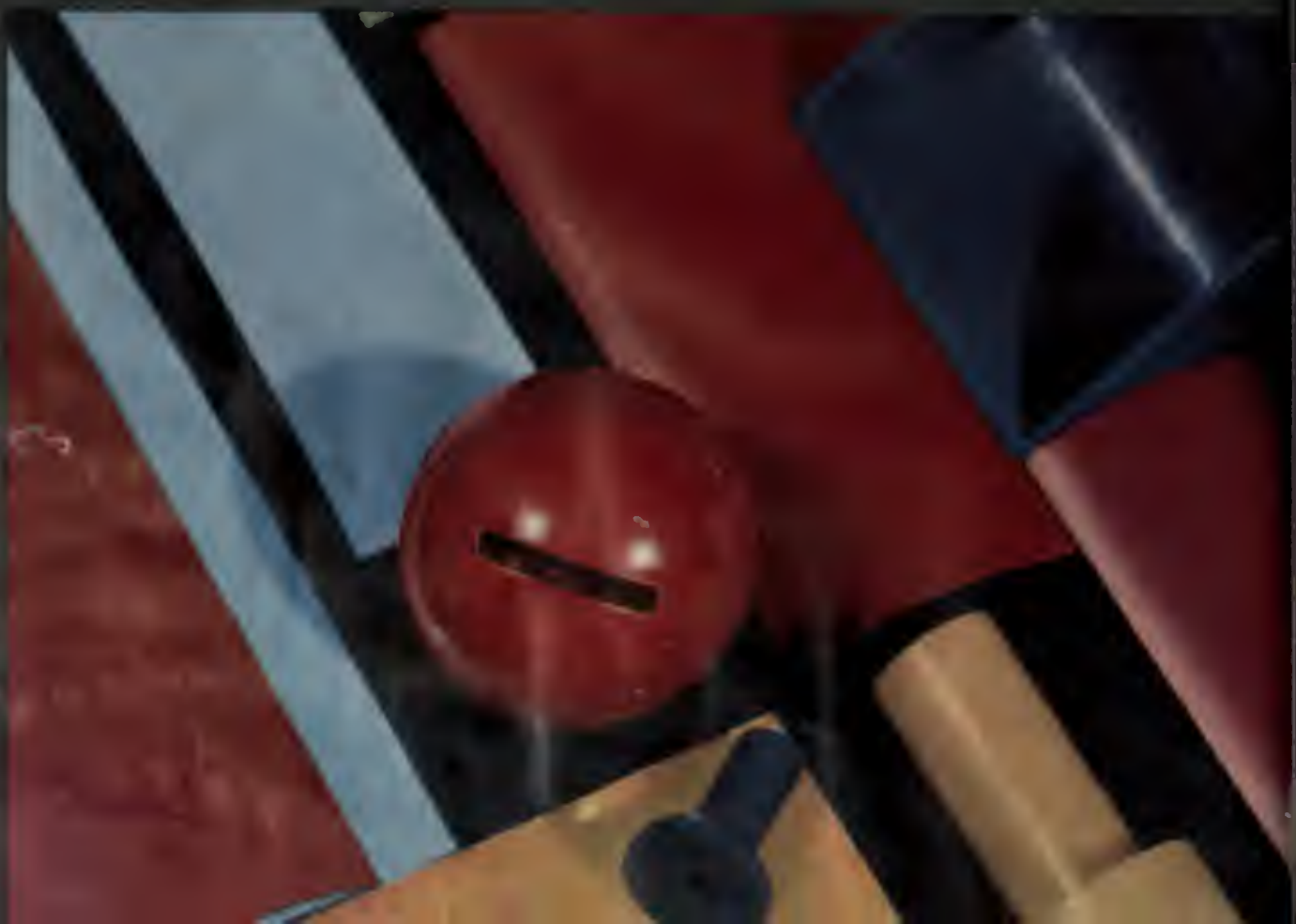
The next step is to spray on a desired color, as shown in the photograph below, the colors being provided in the form of aniline dyes. Non-plastics parts are added to the assembly, and the article is then finished.

To date, these sets have been made only of acrylics, but the company plans to utilize styrene and cellulose acetates as well later on. END

Following the injection-molding process, desired color is sprayed on the object in the form of an aniline dye.

Strong, fabric-filled phenolics, shown against resin-impregnated fiber-glass cloth, are ideal for industrial use

Where color is important in urea plastics, those fillers which dull their delicate pastel hues should be avoided



Fillers—

Their Effect on Molding Material

By Gilbert C. Close

PURE plastics resins, especially those used in molding, are like pure metals in that certain additional ingredients vastly improve specific qualities demanded by engineering design.

Such additives, known as fillers in the case of plastics, may be any one or combination of a number of substances that will impart desired qualities to a resinous composition. A comprehensive knowledge of the various filler materials available, and the effect each will have on a plastics composition, is of vital importance both in plastics design and fabrication.

Molded plastics will play an important role in post-war design, both thermosetting and thermoplastic varieties lending themselves in an economical and efficient manner to molding processes. One of the most important factors in determining the physical characteristics of a molded plastic is the type of filler used. This is especially true of the widely-used phenolics.

Plastics engineers recognize the importance of filler material to such an extent that it is becoming common practice to identify plastics chiefly by their filler content. The terms asbestos-filled phenolics, fiber-filled phenolics, wood flour-filled phenolics, etc., designate certain of the phenol-formaldehyde compositions widely used in the molding process. In certain instances where the resin-to-filler ratio reduces the plastics content to the level of a bonding agent, all reference to the plastics content is dropped and the object is identified directly by name. Resin-bonded abrasive wheels and powdered lead bearings are two such items.

The physical characteristics of most plastics compositions will vary directly with the resin-to-filler ratio. Whether such a variance is desirable will depend upon the use made of the product. Without a filler, or with only a small quantity of filler, strength of the composition will be determined by the continuity and degree of polymerization. This is especially true of the phenol-formaldehyde resins, where tensile properties are a direct result of the benzene-methylene linkages throughout the polymeric structure.

On the other hand, as filler content increases and the plastics content is reduced to a point where it serves merely to bond the filler particles together, tensile qualities will be determined by the adhesion between the plastic and the surface of the filler particles. In this case the strength of the filler material itself will be a factor if it is of a fibrous nature.

(*Continued on page* 105)

Production costs may be reduced and physical properties improved by wise use of filler in extruded tubing and molding

Filler-to-plastics proportion is high in resin-bonded abrasive wheels. Wheel above is polishing aircraft arresting hook

Melurac—A Boil-Resistant, Durable Adhesive

By W. H. MacHale

Plastics Division, American Cyanamid Co.

This Low-Cost, High-Melamine-Content Product Possesses Many of the Advantages of the Ureas

THE general public knows little about the plastics industry, undoubtedly deriving its limited knowledge from molded products, since these are the things it sees and uses most often. Actually, the molders represent only about 20% of the whole, so in effect only a small portion of the full picture is readily appreciated and understood. Be that as it may, there must be an advantage, large or small, that can accrue from a more widespread dissection of the industry for the benefit of all concerned.

For example, little information has seeped through to the average man regarding the great quantities of resins used for surface coatings, laminating varnishes, textile applications, and adhesives. These applications—many of them war-time developments—are, naturally, less apparent than the developments which have been publicized. Yet their great contribution to the war effort is qualified only by the highly significant role they are destined to play in our postwar industrial economy.

At the outset of hostilities, urea-formaldehyde resin adhesives and phenolic resin glues were about the only synthetics which had found application in the wood joining field. The ureas were being applied both as cold-setting and as hot-press adhesives and provided plywood of excellent resistance to mild exposure to the weather or to cold water. The phenolics of that time were all strictly hot-press adhesives, requiring for their cure hot presses at temperature in the neighborhood of 300° F. The phenolics, however, provided a most durable bond, stable in boiling water and capable of withstanding the most severe weathering tests. Aircraft plywood specifications were drawn up around a 3-hr boil test which established the phenolic adhesives as the only permissible synthetics then available.

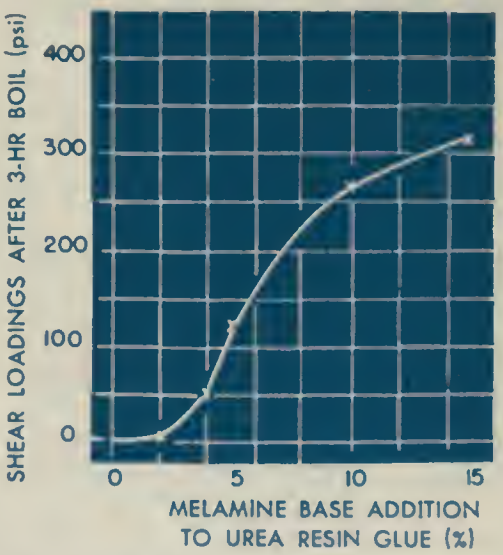
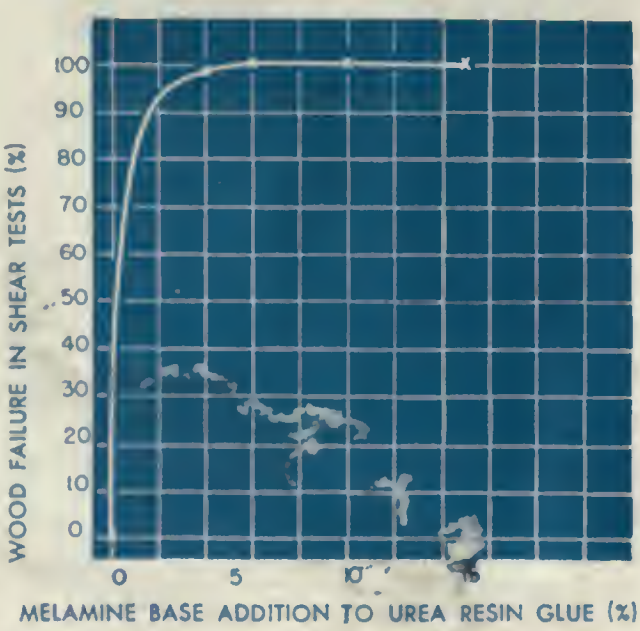


Fig. 2. Shear samples were 3-ply yellow birch plywood boiled 3 hr before test; 10 min cure at 240° F; organic acid catalyst

Fig. 1. Shear samples were 3-ply yellow birch plywood soaked in water 24 hr at 75° F; 10 min cure at 240° F; organic acid catalyst

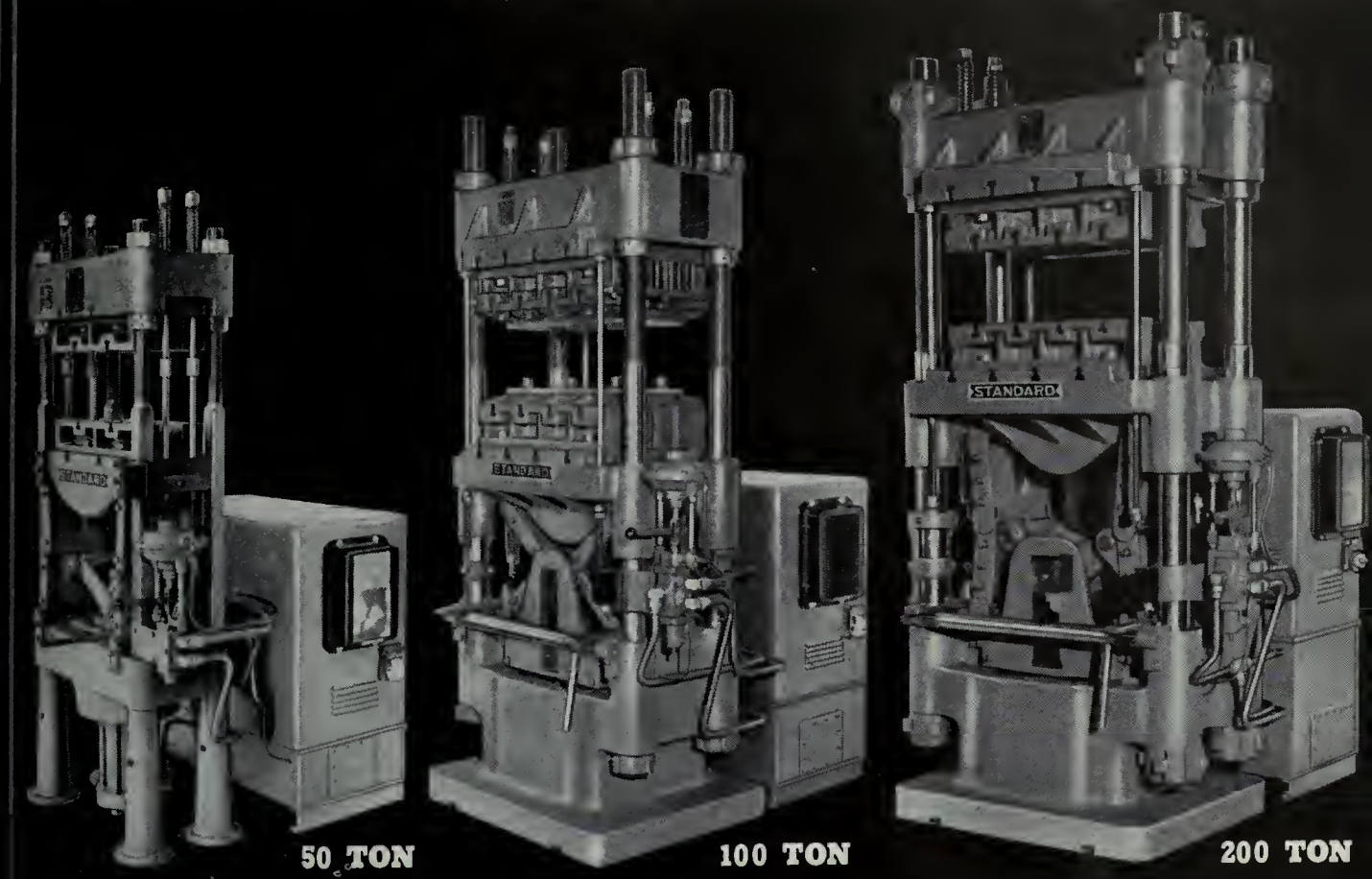


About this time, melamine adhesives made their appearance and were found to present several advantages as hot-press glues. They provided a bond far surpassing specification requirements and did not discolor fine woods. The melamine glues were capable of being set at much lower temperature than the phenolics, 220 to 260° F, as compared to 280 to 300° F for phenolics. The new synthetics had the further advantage of being neutral, neither acidic nor basic, and were thus free from the possibility of degenerative action of chemical attack upon the wood fibres. However, in spite of many virtues, melamine glues were new and expensive and could not compete with the lower priced phenolics.

The American Cyanamid Co., producer of both urea and melamine adhesives, early learned that when melamine resins are added to less noble resins, the mixture is endowed with their properties of water resistance and chemical inertness to an extent far exceeding expectation based on the percentage of melamine involved. The same

(*Continued on page* 111)

STOKES "STANDARD" PRESSES



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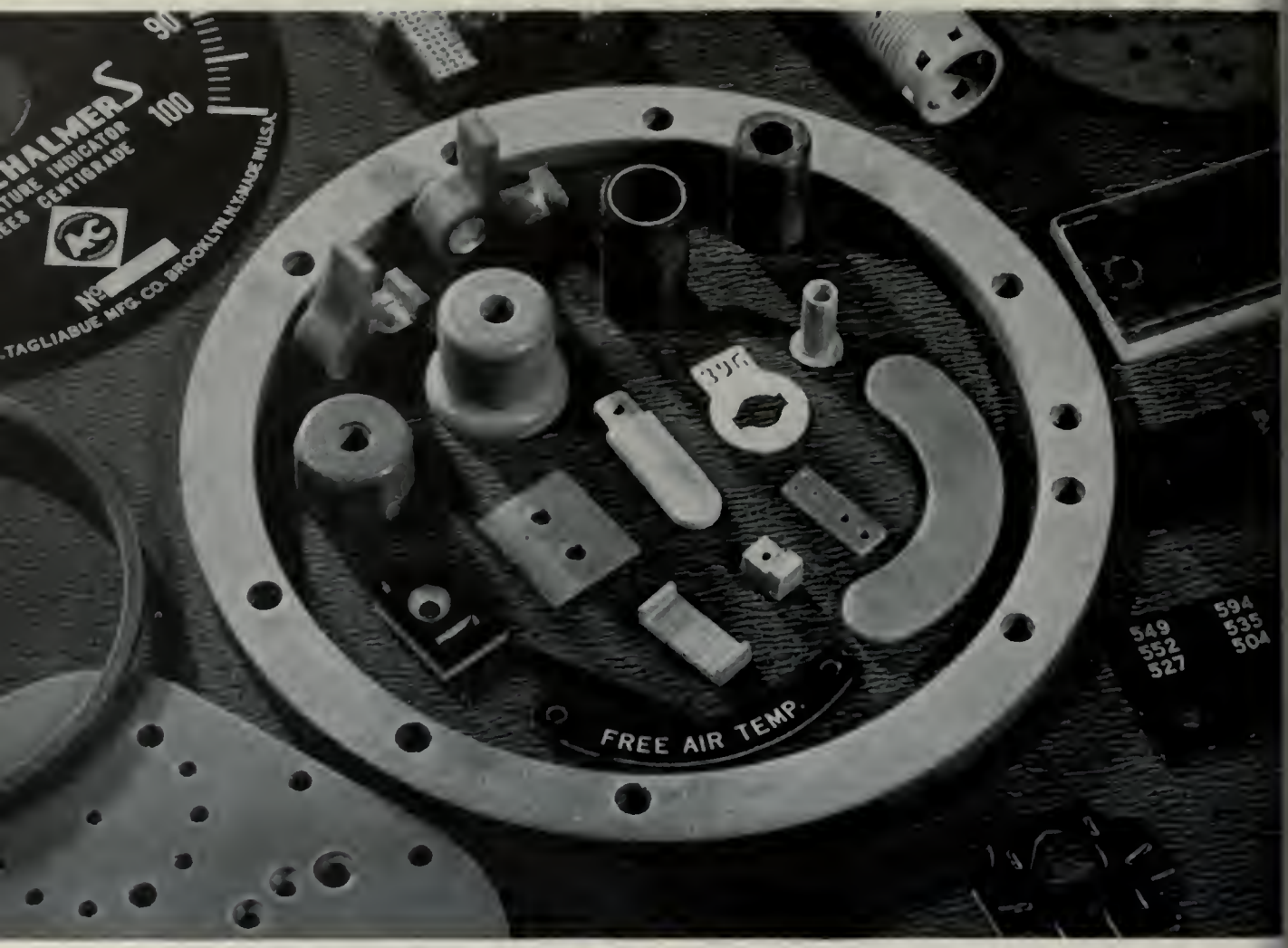
"Standard" Presses are complete self-contained units. Low hydraulic pressures (500 to 1100 lbs.), with accompanying freedom from leaks and high maintenance costs, actuate triple-toggles to produce desired molding pressures (up to 300 tons). Presses are flexible . . . readily adjustable to meet exact pressure requirements of the mold. Because of toggle action presses are quick-acting, automatically slowing down and closing only as fast as material will flow. There's no "cocking" of mold, no excessive wear and tear on mold inserts. One "finger-operated" four-way valve controls entire operation. One operator frequently runs up to six presses—the press closing, breathing, curing, opening and ejecting automatically. Split-second timing of these operations are responsible for securing from 30 to 50 per cent more heats per hour, multiplying production. Many other cost-cutting features. Built in six sizes from 20 to 300 tons capacity.

F. J. STOKES MACHINE CO.
6040 Tabor Road Philadelphia 20, Pa.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895



Electrical insulation is one of the broadest fields for phenolics, as shown by this array of "Formica" parts

PHENOLICS POST-WAR . . .

By E. F. Lougee

Chairman, Advisory Board
Plastics Industries Technical Institute

New Machinery, Processes Broaden Scope of Phenolics To Include Numerous Applications Hitherto Dominated by Other Types of Plastics

PHENOLICS, which have led the field of heat-hardening synthetics for 35 years, have proved to be one of the most critical of all materials during the war period. Research aimed at finding substitutes has not turned up many which can compete with phenolics in strenuous tests, and when civilian production is resumed, phenolics undoubtedly will rebound to prominence in civilian goods. Many spectacular discoveries have occurred since phenolics were first developed which temporarily have focused the spotlight upon the possible threat of new materials to phenolics markets, but ever since dependable government production figures became available, it has been found that phenolics have consistently out-produced all other plastics materials, both here and abroad.

That is not to say that phenolics are *better* than all other plastics, but that inherent properties make their application suitable to a broader industrial field. To reach a true evaluation of phenolics and understand the position they will undoubtedly occupy, we must look beyond their common use as molding compounds. We shall see their superlative insulating properties extending beyond molded insulation into building operations, air conditioning and refrigeration. We shall discover their advantages in coatings and adhesives; their casting qualities embracing new industrial duties far beyond jewelry and decorative items which sponsored their original introduction.

The bazooka, a formidable, yet inexpensive battle tool, is made of canvas impregnated with plastics, then rolled on a mandrel and baked. It is so light it can be carried by one man, yet can knock out enemy tanks and minor fortifications. The new super-bazooka, which launches rocket bombs from landing craft to cover invading forces, can be carried right along with the landing party

More sales are made . . . turnover is greater and profits are larger . . . on products decorated with Meyercord Decals. Why?

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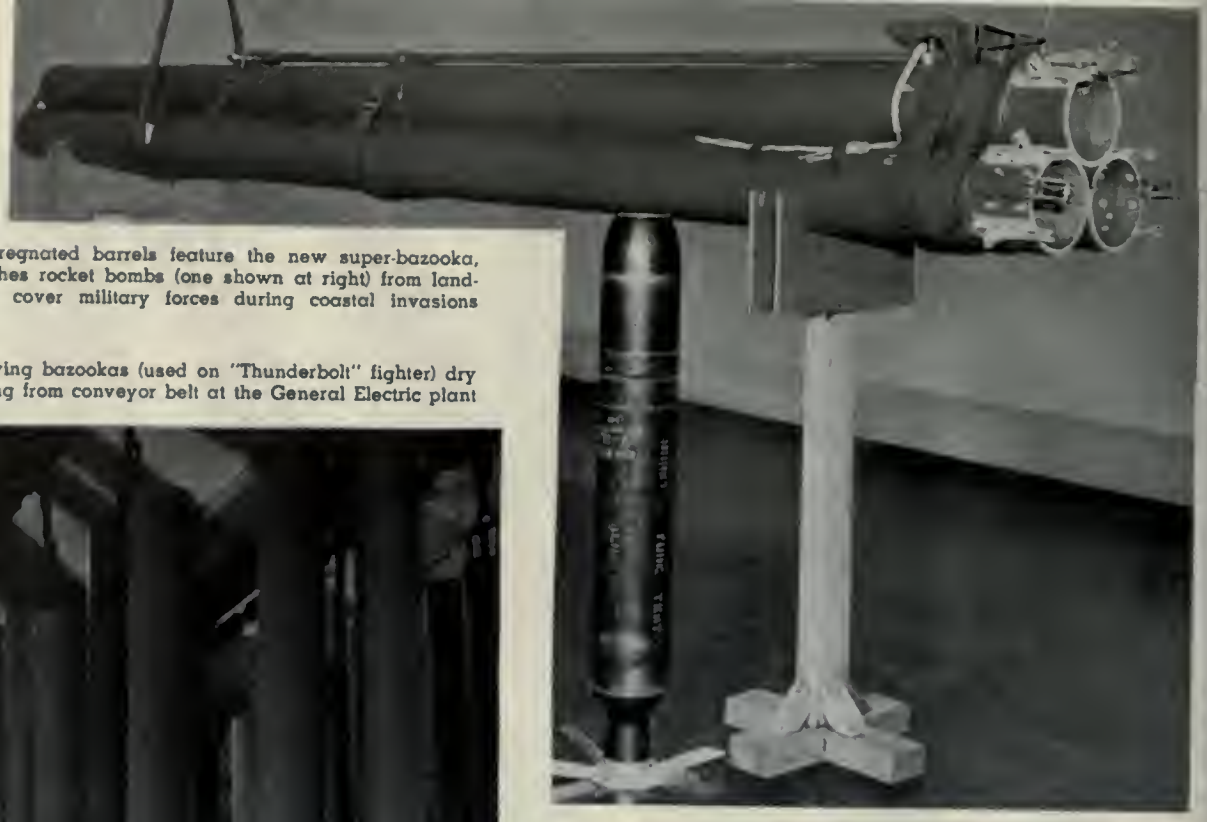


Phenolic-impregnated barrels feature the new super-bazooka, which launches rocket bombs (one shown at right) from landing craft to cover military forces during coastal invasions

Barrels of flying bazookas (used on "Thunderbolt" fighter) dry while hanging from conveyor belt at the General Electric plant

to demolish fortifications and diminish the efficiency of tanks. It is made of a large triple cluster of plastics paper tubes like the original bazooka, and can be transported by one man.

Radio tube bases are made of phenolics because they make good insulation and are quickly molded. So are battery cases, instrument panels and housing, timing gears, gun grips and dozens of other vital devices in tanks, jeeps, trucks, submarines, battleships, landing barges, bombers, fighting and reconnaissance aircraft, as well as at airfield, communication centers, and on every fighting front.

The de Haviland *Mosquito*, which bombs Germany so effectively, is made mostly of plastics and wood—plywood bonded with phenolics resin film and rapidly molded to shape by methods which made it possible to turn them out by the thousands when they were needed most. There's not a rivet in a skyfull, yet they have delivered as much damage to Germany and her satellites per pilot as any other fighting ship, and they cost a lot less to build.

Landing craft which scrape their bottoms across coral reefs, and practically climb up on the beach itself along strange shores throughout the world, often are made of plastics combined with unconventional boat-building materials. Almost everything one can think of is used in one way or another—from Osnaburg to rope and from glass fabrics to wood—and always there are plastics to bond them together and make them water-tight, buoyant, and tough. This is one job phenolics does not claim exclusively as its own, although phenolics are more often used.

Landing craft vary in length from 36 to more than 300 ft. Those with metal surfaces are often protected by phenolic resin incorporated in the special coatings applied to the under surface and to their camouflaged superstructures and sides. Phenolics help such coatings resist the erosion of wind, rain, ice and snow as well as the corrosive action of almost every type and temperature of sea water in all parts of the world.

Then there are boats dropped from the sky by parachute

to rescue flyers downed at sea; expendable gasoline tanks; marine markers; portable X-Ray assemblies for emergency operations in flying or floating hospitals; gun turret grips with a deadman trigger; special compasses for armored vehicles; and clinometers which show the "list" of ships. All these items are indicative of what we may expect of phenolics when they come home from the wars.

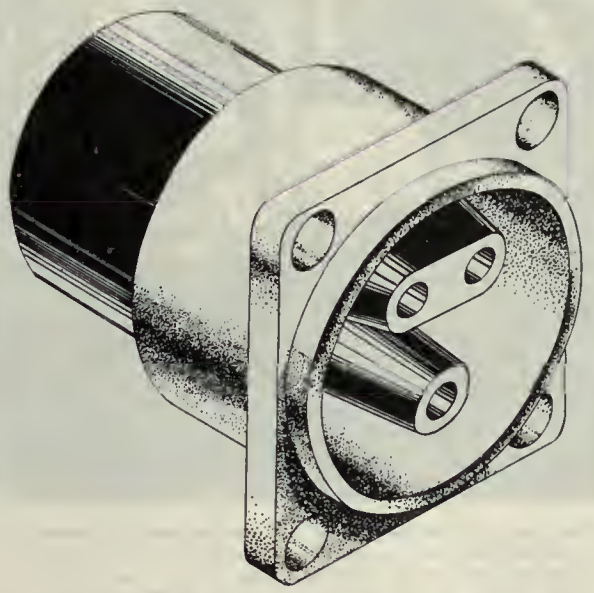
Comparisons may be odious but they smell no worse than some of the mistakes made without their benefit. There is no safer way to choose the right plastics for any specific job than to compare their physical properties and characteristics against the field of available materials, plastics or otherwise, and check each one against service conditions which may affect these properties adversely once the part is made or the plastics applied. These properties are readily available from manufacturers of the materials so there is no need to repeat them here.

Since heat is one of the worst enemies of all plastics, it is well to remember that phenolics will not melt. They will stand higher continuous temperatures than almost any other plastics, except cold-molded, and therefore make a good choice wherever resistance to heat up to 300-400° F is one of the conditions to be met. If a continuous temperature above 250° F is anticipated, a phenolic with the proper filler to withstand this heat should be used.

Other common properties to watch and compare include: Resistance to acids, alkalies and moisture absorption; dielectric, impact, compressive, and tensile strengths; resistance to abrasion, shrinkage, cold-flow, and solvents: ability to hold inserts; machining qualities; and economy of manufacture; where phenolics generally hold a favorable position. With the exception of cast phenolics, and laminates in which the top sheet is non-phenolic, light pastel shades of color are seldom used because of their tendency to "yellow" with age.

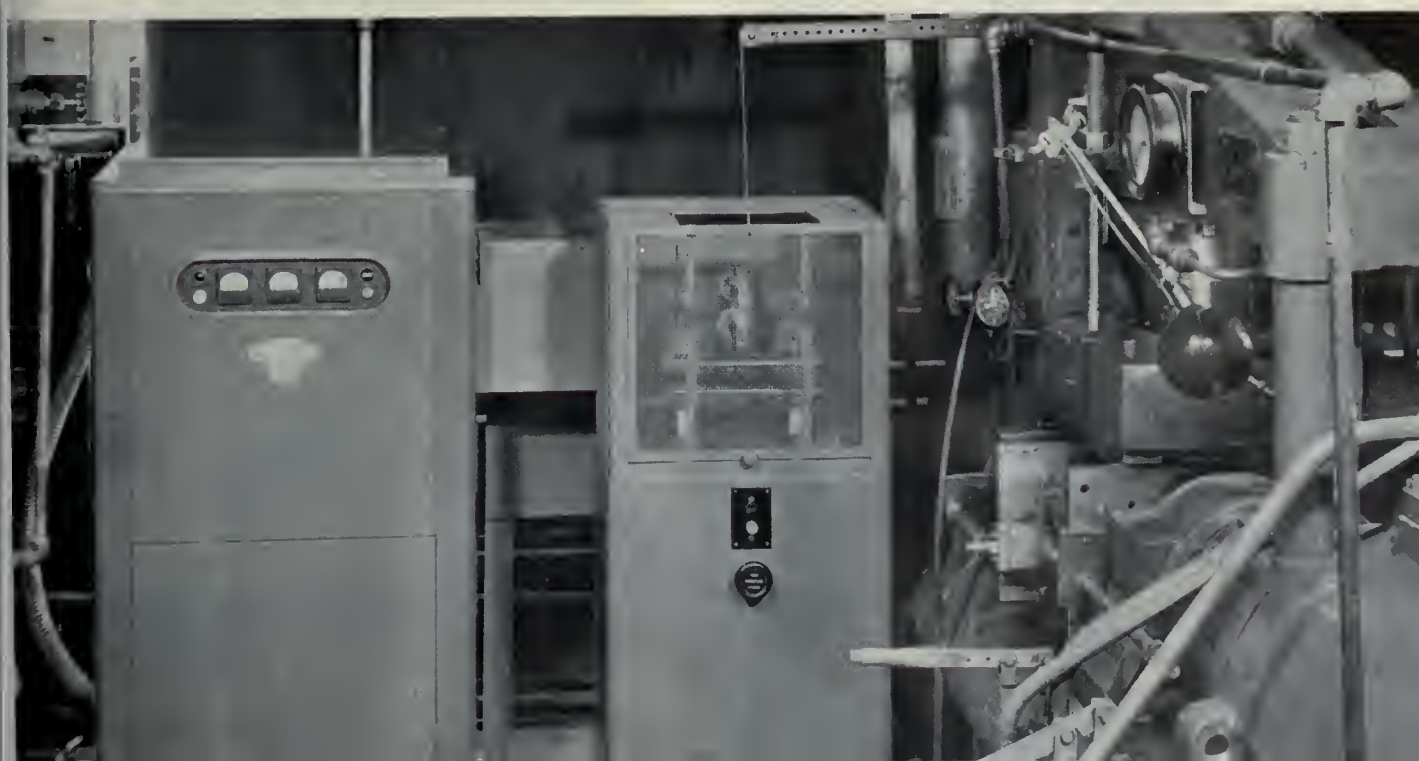
It is not easy to draw a hard and fast set of rules by which the proper plastics may be chosen for specific applications; there are too many factors to consider. There are too many angles which affect either the cost or the quality of the end product and each must be weighed against the other before a choice is made. Although

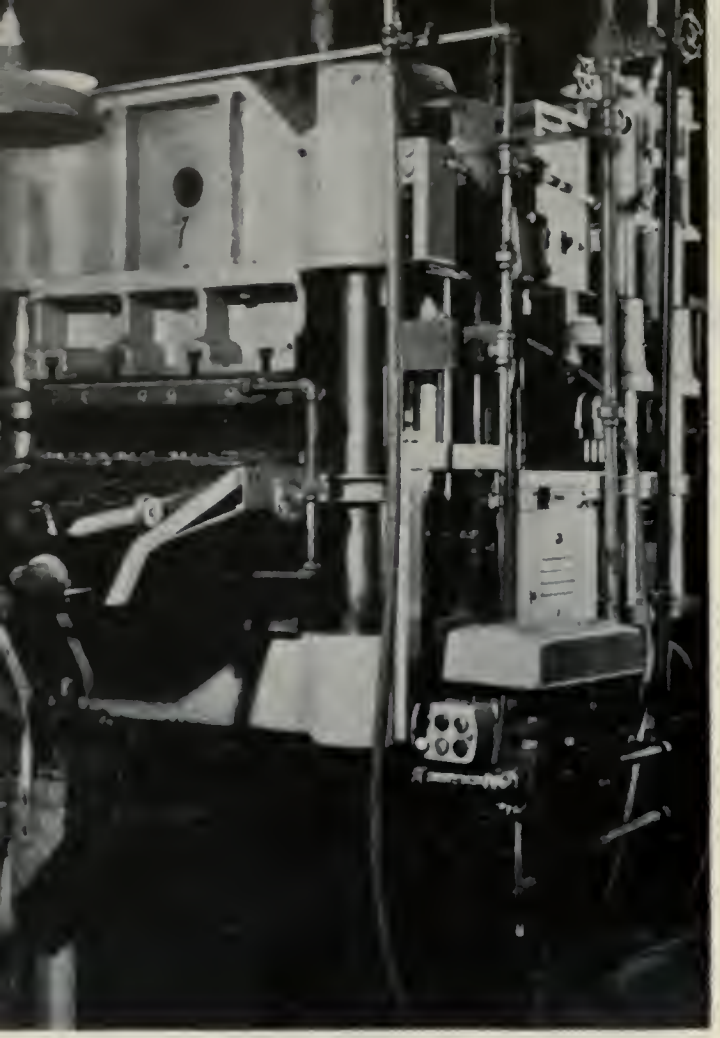
Molded magneto housing made from textile-strengthened phenolic



Phenolics used in Cannon plugs for resistance to high voltage

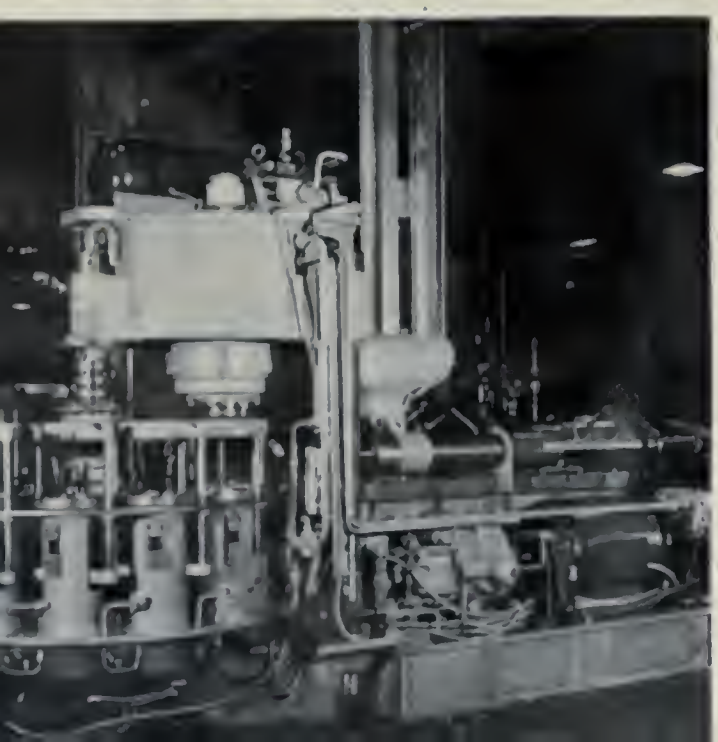
Machines such as Induction Heating Corp.'s high-frequency unit for pre-heating of molded parts, reduce time as much as 50%, produce even heat and cure perfect control; promise to extend phenolics field





The "robot" automatic electric compression molding press at Boonton Molding Co., showing load of parts being transferred from mold to de-flashing hopper. Press has already closed again on its fresh load of pre-heated preforms

Special machine developed by Hydraulic Press Manufacturing Co. for injection molding of thermosetting materials. Unit is fully automatic. Note turret with several mold stations. Molds electrically heated, hydraulically clamped



phenolics are among the lower cost plastics, the surest way to court disaster is to choose plastics on the basis of price-per-pound without taking into consideration all other factors which may add up to an excessively expensive choice in the end.

Before the war, approximately 40% of phenolics production went into molded parts. Another 25% was consumed by paints and varnishes; 20% by laminated products; the balance went into a variety of miscellaneous uses which were little known. Just how war production changed this ratio is not known.

There was a time when thermoplastics costing around 50c a pound could compete favorably on a price basis with phenolics at 12 to 20c per pound because they could be molded more rapidly in an injection machine. Such competition, of course, was limited to products where either thermoplastics or thermosetting materials were equally suitable to the application. Mold costs were often lower because an injection machine discharges its molded parts in a matter of seconds while conventional compression presses molding thermosetting materials required minutes to cure the materials. This means that a 5-cavity injection mold, operating on a 6-sec cycle, could turn out 50 parts a minute while a compression mold requiring 1 min to cure its load would need a 50-cavity capacity to equal production. Naturally, the 50-cavity mold would cost more than the 5-cavity mold and a comparatively greater capital investment would have to be charged against the job. Also, it would take longer to make, and where speed counts, the injection mold could be put into operation before a 50-cavity mold for the compression press could be made.

Many things have happened which alter this condition and will extend phenolics and other thermosetting materials into products formerly employing thermoplastics because of economic manufacturing advantages: High frequency preheating, improved automatic presses and jet molding are prominent improvements which manufacturers will do well to investigate before choosing their materials. The well-equipped molding plant will make use of these innovations if high production is to be maintained, and such plants will attract a broad clientele from new fields.

High frequency preheating is especially adaptable to transfer molding, a process patented by Shaw Insulator Co. This is one of the most highly accurate molding methods where tolerances can be maintained to tight engineering specifications and inserts positioned accordingly with little danger or damage when pressure is applied. Hitherto, transfer molding was slow and costly because the method involves heating the plastics materials in a separate chamber above the mold until it is sufficiently plastic to flow through tiny openings, or gates, into the positive mold below where it remains to cure. The plastics material, being a natural insulating substance, took its time to heat through and minutes ticked away while an operator stood by.

With high frequency preheating, the material is brought quickly almost to molding temperature before it is placed in the transfer chamber. The press can be closed rapidly because mechanical resistance of the softened material is practically nil, and the whole cycle is shortened from 50 to 75%. One pre-heater usually can service two presses and frequently they are operated by one operator which cuts both press time and man hours to a point where the obvious advantages of transfer molding are little, if any, more costly than ordinary compression methods.

High frequency preheating is valuable also to conventional compression molding especially where thick walls exist because it permits more even cure throughout the piece. This is essential if maximum properties are to be developed in the molded part. It is easy to see how failures

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LANCE Manufacturing Company

FIFTH & COURTLAND STS., PHILADELPHIA 40, PA.

HPM 12-oz injection molding machine converted to jet molding with unit furnished by Plastics Processes, Cleveland

occur in some plastics parts which may be overcured on the surface, yet remain crumbly with undeveloped strength beneath the surface in thick sections because the heat which would eventually cure them into a homogenous part had to be withdrawn to prevent burning the surface. Where plastics preforms are brought within a few degrees of molding temperature by high frequency heating, they flow promptly and cure evenly throughout.

Automatic presses have been so highly developed and improved that phenolics (and other thermosetting materials) can be molded as rapidly nowadays as any thermoplastics materials and their lower cost per pound, their stability in service, and greater resistance to heat, will recommend them for many applications formerly dominated by thermoplastics.

This does not mean that thermoplastics will not find many applications where their transparency and brilliant colors make them more desirable than the opaque dark shades of available phenolics, and where their more flexible nature will dictate their specification in preference to any other materials. However, in industrial applications, where the ultimate cost per piece is a deciding factor, and where phenolics will serve the purpose as well or better than thermoplastics, the latter materials will lose some of their former advantage in low cost production through injection molding.

Jet molding, developed by C. D. Shaw, Plastics Industries, Inc., is comparable to injection molding in that thermosetting molding compound is placed in a hopper where it feeds automatically through a heating chamber into the mold where its final "set" takes place. The main difference between jet molding and injection molding exists in the difference in behavior between thermoplastics and thermosetting materials. Thermoplastics are squirted into a cold mold where they "chill" to shape and may be quickly removed. Thermosetting materials, on the other hand, must be given time in the mold to "set" by polymerization. In other words, thermosetting materials, such as phenolics, require both heat and confined pressure to bring about the chemical and physical change which finally converts them from a soft mass to a solid molded part.

In order that no press time be wasted during this final cure of phenolics, one manufacturer, Hydraulic Press Manufacturing Co., has developed a jet molding press with several polymerization chambers or molds, mounted on a revolving table. As one is filled by injecting the semi-liquid plastic into the closed mold, it moves to its next station where pressure is automatically maintained while another mold from which its completely cured part has been discharged, moves into position to receive a fresh charge. This makes the molding operation continuous and almost parallels the procedure of injection molding except that several duplicate molds are required, one for each station.

This principle is not entirely new. Automatic presses with rotating stations, such as those developed by John Lauterbach, have been used before, but they were formerly more or less conventionally operated by feeding cold powder into each mold as it passed by the hopper. From there on the molding cycle was conventional; the powder was heated under pressure until it flowed and cured in the closed mold. In jet molding the cycle is speeded considerably in that the compound is heated to a semi-liquid stage before it enters the mold and cures more rapidly.

Then, there is the robot press, a glutton for production, developed by Boonton Molding Co., which is capable of turning out upwards of 250,000 parts each 24 hr. The parts are usually small, such as bottle closures and buttons, but production is prodigious. The machine operates along conventional lines except that each operation is automatic and electrically controlled. Molding compound is elevated directly from its shipping drum by bucket chains into a loading platform atop the press. Here it is weighed and measured accurately and dropped by gravity through tubes into preform cavities near the rear of the press. As the press operates, these preforms are pressed and heated, then passed along to a loading board which at the proper moment drops one into each cavity of the mold where it gets its final cure. The cycle is rapid because the preforms have been heated electrically before they enter the mold and no time is lost in closing the press.

Parts are discharged into a wire basket which gives them a rugged shakedown, much like a corn popper, and removes most of their surplus flash before dumping them into a carton which carries them to the finishing and inspection departments.

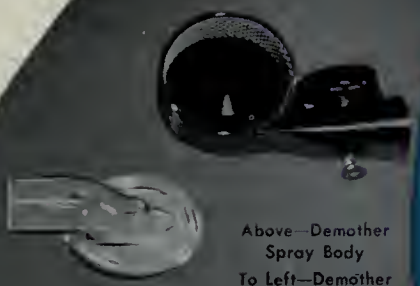
There are other press improvements to be sure, but these briefly detailed are most likely to effect economical production of phenolics parts and should be given due consideration by manufacturers of any merchandise where these versatile plastics will contribute to their efficiency and sales.

When the plastics industry first offered its services and products to military production, progress was slow. Beachheads were small and hard to hold. There was sniping from many quarters by those who felt honestly sure in their hearts that nothing could take the place of metals in munitions requirements. When there just wasn't any more metal for the things needed urgently, plastics came in for serious experimentation, and it was soon learned that plastics had not reached their zenith in engineering properties; that the chemists who cooked carbolic acid with formaldehyde could improvise formulas with many different flavors to suit almost any problem to be met. It was then that close cooperation began which resulted in the first military applications where plastics cut costs and corners no one could foresee.

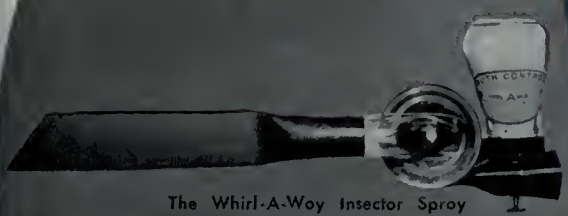
This does not mean that plastics are destined to replace metals in civilian production any more than they did in all military production. In the beginning they were used as substitutes to be sure, but when it was found that in certain applications plastics stood up better in service than the metals they replaced, it wasn't long before phenolics became more critical than some metals. Their production jumped with amazing speed; still there were not enough to go around, and allocation to essential jobs became necessary. Even now, with most metals more plentiful than at any time in history, plastics go on performing their new assignments with credit to the chemists and engineers

(*Continued on page 109*)

SOMETHING TO SPOUT ABOUT



Above—Demother Spray Body
To Left—Demother Spray Body Cover



The Whirl-A-Way Insector Spray completely assembled . . . a product of Air-Way Electric Appliance Corporation, Toledo, Ohio.

The plastic piece illustrated above is a component of the Whirl-A-Way Insector Sprayer . . . and to qualify as such the requirements for its design and construction were most exacting. Certain chemicals were to pass thru its cavities — thus necessitating the use of a plastic material inert to chemical reaction. The action exerted upon the crystals, by a forced air stream, created a gas-like snow; its formation and efficient ejection, therefore, demanded a leak-proof assembly and an accuracy of manufacture to the closest possible tolerance.

For the material, Consolidated chose a special black Phenolic, and for its production, designed and built a two-cavity, semi-automatic transfer mold die, involving removable threaded plugs, cam-operated core pins and a mold parting line departing from the straight plane.

The piece as finished weighs 3¾ ozs., has a wall thickness of .100" and is giving a good account of itself in service . . . as is also one other Consolidated plastic part in this assembly . . . the injection molded clear acetate cover.

In detailing this achievement we have in mind that we may be able to help others with similar problems; if so we solicit the opportunity.

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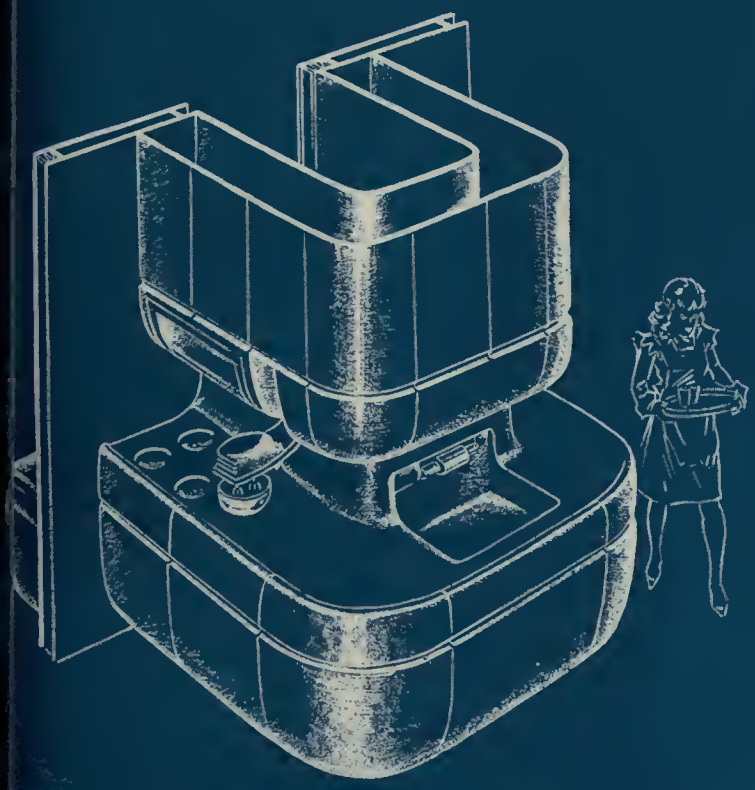
ON THE DRAFTING BOARD

Drawings by Julian Krupa, Plastics' Art Department

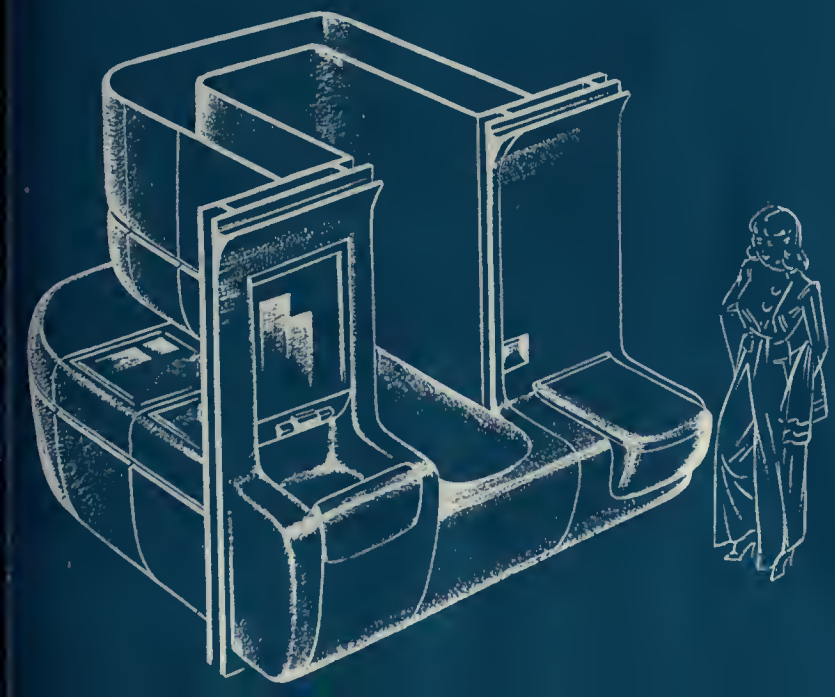
Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

(PLASTICS welcomes designers' contributions to this department)



Using "Valinite" low pressure molding, bath and kitchen fixtures are formed integral with standardized interchangeable wall sections in this pre-fabricated utility unit, having lower shelves with racks which permit vertical stacking of dishes. A high oven is over the stove. Bathroom fixtures are built in, flush. Tub walls extend to the ceiling, making a shower room as well. A recess is provided for the shower curtain. A Sundberg-Ferar design

An all-plastics chair designed by Sundberg-Ferar, Detroit. The body is a molded unit in black, while the decorative legs, of transparent acrylics, are fitted in. Upholstery is a woven extruded plastics which is easily cleaned



This novel night-table lamp of a thermosetting plastics is designed by Henry P. Glass of Chicago. Noteworthy is the idea of working the starter, ballast and switch into the base. Two 15-watt fluorescent bulbs supply lite

Polystyrene Drain Jar Eliminates Battery Leakage

Polystyrene battery jar parts: Jar, cap, two vent tubes. Note tube halves, integral straight tube, tubes inserted in cap

By Carl A. Raabe

Manager, Synthetic Materials
American Phenolic Corp.

Transparent, Dielec
Acid-Resistant, Li
Polystyrene Is Suite
Varied Electrical

THE properties of polystyrene and the possibilities of injection molding recently solved one of the problems confronting the aviation field. This is an excellent example of how the elimination of fabricating difficulties has enabled industry to select that particular plastic which fits each specific requirement.

Featuring crystal transparency, high dielectric quality, and being both moisture and acid-resistant, polystyrene is chemically an old story, but commercially, a new-born babe. It was the development and refinement of injection molding and controlled molecular weights that made new commercial applications possible. Older methods of compression molding, in which the mold itself is heated, work out more satisfactorily with thermo-setting materials. These, when subjected to heat and pressure, take form and harden permanently.

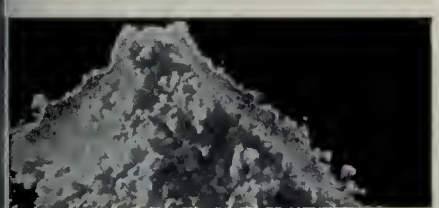
Polystyrene, however, is classified as a thermo-plastic—that is, it must cool to a given temperature before it can be removed from the mold. Thermo-plastics become hard and stay hard only at relatively low temperatures, and when moderately heated, prove practical for injection into an unheated mold. The word "relatively" is used advisedly because these softening points, in the case of polystyrene, 162°-180°, are of sufficient intensity to be ignored in many highly valuable applications of plastic parts.

Storage batteries used in cars and planes must have vents to relieve gaseous pressure generated in the batteries. In a car these vents present no problem. But in a plane, particularly a fighter, situations develop which often take the battery through a complete cycle—rightside up and upside down. The vents thus release battery acid to fall on the floor, the sides, and the top of the plane.

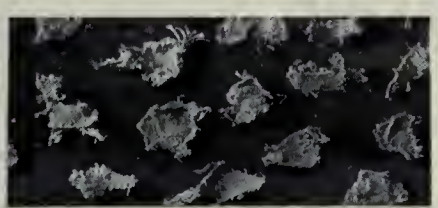
Amphenol has succeeded in developing a battery drain sump jar to answer this problem. This jar is strapped to

Also exemplifying the value of polystyrene in electrical applications is this "comb" for coil forms. Note wire grooves

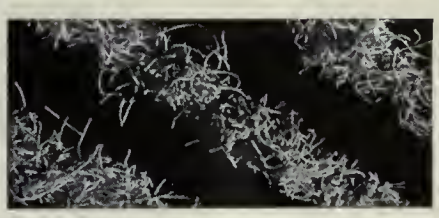
EXTRA-STRENGTH Plastics with RAYCO Fillers



FILFLOC Pure cotton flock of surpassing cleanliness and uniformity.



FABRIFIL Macerated cotton fabric for extra strength.



CORDFIL Evenly cut lengths of tire cord for plastics of utmost strength.

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This is an excellent low-priced molding compound of the phenol formaldehyde type. It can be used on a considerable variety of items—information available upon request.

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the side wall of the plane with the flat side of the cover against the plane wall. Fastened in that way the cover cannot be taken off without taking the jar from the wall. A heavy felt pad, saturated with a neutralizing agent is placed on the bottom of the jar. A transparent vinyl tube carries the overflow acid from the battery to the jar. From the jar a transparent flexible vinyl vent tube goes to the skin of the ship. Any battery fluid which may be sucked out through the latter tube is completely neutralized and cannot therefore injure plane or anything it may touch. The jar itself is emptied every two or three days and the neutralizing element in the felt pad is renewed. The frequency of this operation depends upon the number of hours the plane is in the air.

Polystyrene was chosen for the jar, the jar cap, and the two vent tubes in the jar cap; vinyl for the flexible tubes and the jar gasket because both polystyrene and vinyl are acid-resistant and neither is affected by age. Polystyrene is durable, transparent and shatterproof—very desirable qualities in plane construction. The whole polystyrene assembly weighs only 5½ oz., a full third less than the glass jar units formerly used for this purpose. The vinyl gasket between cap and jar makes a tight seal when the cap is screwed into place. It is black in color so it can easily be seen through the clear polystyrene.

Both jar and cap are excellent examples of the possibilities in injection molding with skillful operators and the latest type of equipment. The threads are molded.

Both rigid tubes, one shown right angled and one straight in the illustrations, are also injection molded. The straight tube is molded in one piece. The right-angled tube is molded in two halves which are then welded together with *Polyweld,* a liquid polystyrene developed by American Phenolic Corp. Both tubes are welded into the cover with *Polyweld,* making the cover and tubes a complete homogenous unit. Molding tubes and cap separately makes it possible to vary the complete unit to suit exactly and conveniently the position of battery and jar in the particular

(*Continued on page* 105)

Properties of Ultra Low-Loss Polystyrene—"Amphenol"

Light transmission (%)	88—90
Refractive index	1.59
Dispersion $\left(\nu = \frac{^{n}D - 1}{^{n}F - ^{n}C}\right)$	32
Effect of age	None
Effect of sunlight	Slight
Specific gravity unpigmented	1.054-1.056
Specific volume unpigmented	26.3-26.2
General resistance to:	
Water absorption (24 hr at 25°C)	0.00
Weak (mineral) acids	Excellent
Strong (mineral) acids:	
Non-oxidizing	Excellent
Oxidizing	Discolors slightly
Alkalies	Excellent
Alcohols	Excellent
Ketones	Swells
Esters and aromatic hydrocarbons	Soluble
Hydrocarbons—aliphatic	Fair to good
Oils	Poor to excellent
Burning rate	Slow
Thermal conductivity (cal/sec/cm/°C)	3.2×10^{-4}
Specific heat (cal/°C/gm)	0.32
Thermal expansion (lent.)	6.8×10^{-5}
Heat distortion (°C).	72 — 82
Cold flow tendency	Very slight
Volume resistivity (ohm cm)	$10^{17} — 10^{19}$
Dielectric strength—instantaneous: (0.015" thick, v/mil)	2200
Dielectric Constant— 60, 1000, 1,000,000 cycle	2.5-2.6
Power Factor— 60 and 1000 cycle	0.0001-0.0003

Crystal Seal

3 DIMENSIONAL ART IN PLASTICS

—IS A PATENTED PROCESS OF THE GITS MOLDING CORPORATION. THIS PROCESS PRESENTS A TOTALLY ENCLOSED THREE DIMENSIONAL EFFECT OF CRYSTAL BEAUTY. NAME PLATES, DIALS, TRIM, INSIGNIA, COUNTER DISPLAYS, TRADE MARKS, MEDALLIONS, EMBLEMS, SIGNS, ESCUTCHEONS, PLAQUES, BUTTONS, ORNAMENTS, CONTAINERS, STATIONARY AND DESK PRODUCTS, GAME PIECES, HANDLES, KNOBS, DRAWER PULLS, DOOR PLATES, RESULT IN INCREASED VALUE AND EYE APPEAL WITH THE CRYSTAL SEAL PROCESS. QUALIFIED MOLDERS ARE BEING LICENSED UNDER PATENT NO. 2,354,857.

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Crystal SEAL
GITS Molding Corporation

The low moisture absorption of Fiberglas* Textiles...

improves the moisture resistance of low-pressure plastic laminates

FIBERGLAS . . . is the trade name for glass manufactured in fiber or filament form by Owens-Corning Fiberglas Corporation. The Fiberglas fibers, twisted into threads and yarns, woven into tapes and cloths, provide textile materials in all the standard forms used in the reinforcement of low-pressure plastic laminates. Samples and complete technical information on Fiberglas Textiles on request. Fiberglas Corporation does not manufacture resins or finished laminates, but shall be pleased to direct you to sources of supply.

Pioneering fabricators of low-pressure plastic laminates, aiming to produce materials resistant to damage by moisture, turned their attention quite naturally to Fiberglas . . . glass in the form of textile fibers. They took Fiberglas Cloth . . . laminated it with the new contact pressure resins . . . found they could produce materials considerably improved in resistance to moisture absorption.

Moisture resistance means different things in different problems. One problem may involve resistance to water vapor from humid air. Another may involve actual contact with water . . . as in the case of airplane surfaces under exposure to rain. You may be trying to overcome swelling of plastic laminates through moisture absorption . . . or increase of weight from the same cause.

In any case, Fiberglas Cloth Reinforcements should help . . . because Fiberglas itself is unchanged by moisture. The individual Fiberglas Fibers have no cellular structure to absorb or hold moisture. Even if moisture penetrates *around* them it cannot get *inside* them. Therefore, they won't swell or shrink under moisture exposure. And for that reason, Fiberglas-reinforced laminates may be expected to resist swelling and damage from moisture absorption.

Interesting published data on the moisture resistance, dimensional stability and other properties of Fiberglas-reinforced, low-pressure laminates will be gladly furnished on request. *Owens-Corning Fiberglas Corporation, 1881 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

FIBERGLAS *T. M. Reg. U. S. Pat. Off. ***...A BASIC MATERIAL**

Plastic-Coated Fabrics and Post-War Markets

By James R. Owens

Fabrikoid Division
E. I. du Pont de Nemours & Co.

War-Born Additions and Improvements Will Enhance Their Ability to Compete With Unsupported Elastomeric Fabrics

QMC's poncho made of coated nylon, weighing only 30 oz. serves also as ground sheet, bed roll or half of tent

THE post-war prospects of the coated fabrics industry using resins, which have already proven their superior qualities in diversified military service, will depend on how well they are handled. It will be necessary to make a careful and proper selection of raw materials to produce the best plastic-coated fabric for the job. The markets for coated fabrics in post-war will be substantially the same as pre-war, and the resins will provide improved coated fabrics with certain outstanding characteristics to sell in these markets. However, the final product must justify the added quality cost and the functional value of the resin-coated fabric must be used to best advantage.

Coating of fabrics is an old art and the business was well established before the last war. Until the present conflict the principal protective coatings for textiles were drying oils, rubber, lacquer or pyroxylin. However, pyroxylin-coated fabrics were not called "plastic coated" fabrics. If the new resin-coated fabrics are referred to as "plastic-coated" fabrics now, it should be understood that the word "plastic" does not indicate the quality of the coating—a plastic coating can be either "good or bad". Recently, the name "plastic" has been applied to paints and here again their use is not new, and a plastic paint can be good or bad. It is the duty of the coated fabric industry to build the best protective coating for each specific use and synthetic resins and synthetic rubbers should be considered as raw materials or tools to accomplish that objective. The selection of the resin and the compounding ingredients which will do the best job should, therefore, be the aim of the industry so that the consumer will get the "best" plastic coated fabric, the "best" plastic paint or the "best" extruded or molded plastic item.

Soon after war was declared it was quite evident that natural rubber would not be permitted for coating of fabrics, except for the most essential uses. Lacquer or pyroxylin coated fabrics did not have the required military characteristics nor did the commonly used drying oils.

The industry had for some time recognized the possibilities of other film-forming materials to give improved protection and durability to fabrics, and when the war started it was producing in a small way, for specific purposes, fabrics coated with such materials as vinyl resins, alkyd resins, ethyl cellulose, mixed cellulose esters, and synthetic rubbers. This practical experience with the newer film-forming materials, though on a comparatively small scale, was most fortunate as it facilitated the necessary

conversion from oil, lacquer, and natural rubber to synthetic resins and synthetic rubbers.

First, the oil coaters modified their drying oils with alkyd resins resulting from the reaction of polyhydric alcohols and polybasic acids and their anhydrides. The polyhydric alcohols used were generally glycerol and ethylene glycols and the acids—sebacic and phthalic anhydride. The choice of the raw materials used was important because of their effect on the characteristics of the coating. The addition of these alkyd resins gave the coated fabrics improved resistance to low and high temperatures, improved resistance to flexing, and higher resistance to liquid vesicants. These improvements permitted the coated fabrics to be used in gas protective equipment.

Second, the pyroxylin or lacquer coaters turned to the vinyl group of resins for the solution of their problems and excellent results were achieved. This group of resins included polyvinyl chloride, copolymers of vinyl chloride and vinyl acetate, copolymers of vinyl chloride and vinylidiene chloride, and polyvinyl butyral. The last resin is available in both the thermoplastic and thermosetting types. The thermoplastic type, however, lacks certain quality characteristics for some uses and its application was limited. The thermosetting type has much better characteristics but most of the pyroxylin coaters did not have the "curing" facilities for proper handling. Therefore, the coaters concentrated on polyvinyl chloride and the copolymers.

Types of Vinyl Resins

These resins are divided into two classes—those containing over 92% polyvinyl chloride and those containing under 92%. The former are more difficult to put into solution for spread coating, while the latter are more readily soluble at ordinary temperatures in acetone, methyl ethyl ketone and some of the higher ketones.

When the protective coating must withstand a temperature of 40° F the resins containing over 92% polyvinyl chloride are used. When the low temperature requirements are not too severe a 50-50 mixture of the two has proven quite satisfactory. However, up to this time it has been almost impossible to standardize on a single resin formulation because of an almost constant change in availability, plus the fact that coating equipment and coating technique vary among the coaters in the industry.

Selecting Plasticizers

Plasticizers, which also play an important part in the coating formulations, must be selected with great care. Experience has indicated that for low temperature exposure a mixture of solvent and non-solvent types of plasticizers gives good results. The phthalate and sebacate plasticizers are the most commonly used of the solvent type. Ricinoleates and glycol esters of cocoanut oil are representative plasticizers of the non-solvent type. Here again availability has prevented any standardization.

Pigments, fillers, and stabilizers are equally important and the type and quantity used have a direct bearing on the quality of the coating. The ratio of resin, plasticizer and pigment in a coating compound depends on the service which the fabric is called upon to perform. For general purposes a coating compound containing approximately 45% resin, 35% plasticizer and 20% pigment will be found quite satisfactory.

The vinyl resin coated fabrics are giving good material performance, waterproofing both men and equipment. They have good resistance to outdoor exposure and are useful over a wide temperature range, for the coating will not crack at low temperatures or block at high temperatures. They have good resistance to oxidation, oils, alkalies, acids, and most solvents. The fabrication qualities of the coated fabrics are most satisfactory, but the development of the technique required much thought and effort in the earlier days of the war.

Third, the rubber coaters or proofers also converted to vinyl resins and later to synthetic rubbers. Polyvinyl

(*Continued on page* 110)

Among uses developed for vinyl plastic-coated fabrics during war is hospital sheeting

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Casting Plastics for Master Molds

By L. R. Miller

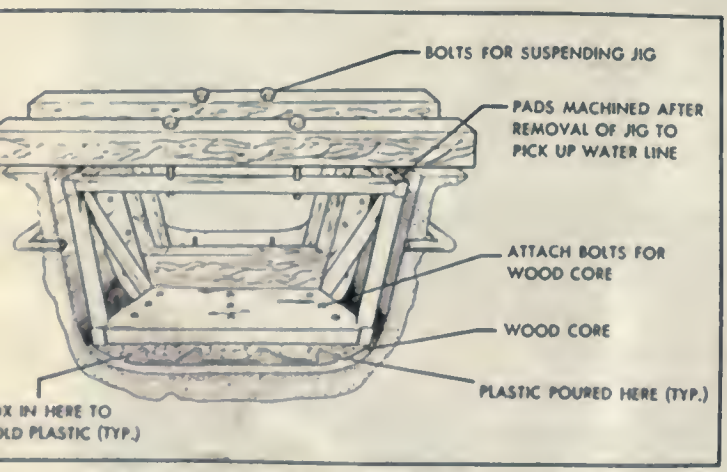
Head of the Plastics Department at Northrop Aircraft, Inc., Hawthorne, Calif., the author formerly had been affiliated with Chrysler Corp. for 5 years following his graduation from the Plastics Industries Technical Institute

Rear view of the plas master jig developed Northrop Aircraft, Inc., a gunner's enclosure fr

THE immediate success of the cast resin type of plastic in the airplane industry has been due to its adaptability for tooling uses. Router fixtures, saw fixtures, check fixtures, drill jigs, and stretch press dies have been among the successful applications introduced and now widely used by most aircraft companies. These cast plastics tools can be produced in a fraction of the time at a fraction of the cost involved in using other materials, and are characterized by ease of fabrication and ability to maintain tolerances.

Among the new tools recently produced at Northrop Aireraft, Inc., was a plastics master model. Walker Plastic Co., Burbank, Calif., assisted in this development.

The material used in this application was a phenolic cast resin manufactured by Nobel Resin Co., Azusa, Calif., under the name of *Phenocast*.



After wood core is located in splash and open sections are boxed in, plastics mix is poured and allowed to set for 8 hr

There have been several attempts to produce new methods for master tooling, and rightly so, as present methods have never been entirely satisfactory. Among the more recent is the use of mahogany for master fabrication. This has been a slow and costly procedure and the result has not always been dependable, due to dimensional instability. Although plaster and hydrocal masters are relatively economical to fabricate, the durability required for present tooling has been lacking.

A plastics master solved these problems because it maintains tolerances, saves fabrication hours, has lasting durability and eliminates subsequent rework.

In using cast plastics in the past, it has been the general practice to cast a tool of solid plastics using walnut shell flour as a filler. These tools, while they served the purpose for quick fabrication, soon developed cracks, lost tolerances, and were subsequently scrapped. An investigation conducted into the cause of this dimensional instability disclosed an excessive amount of shrink inherent in the cured mass. Shrink bar tests showed an original mold shrink of 0.004 in/in and an after-shrink of 0.005 in/in. After many materials were tested it was found that by substituting a more stable filler for walnut flour, this shrinkage could be eliminated. Also, since the amount of shrinkage is in direct relation to the volume, this shrinkage was further minimized by the use of a wood core, greatly reducing the amount of resin used.

With the above information tried and proven, development of a plastics master model proceeded along the lines of least resistance. A model of the gunner's enclosure frame was selected as the first application since there already existed a master to the outside of skin. A plaster pattern was taken and skin and spacer thickness was built up through the use of sheet wax. Waterproof plywood and pre-dried sugar pine, because of good ability to

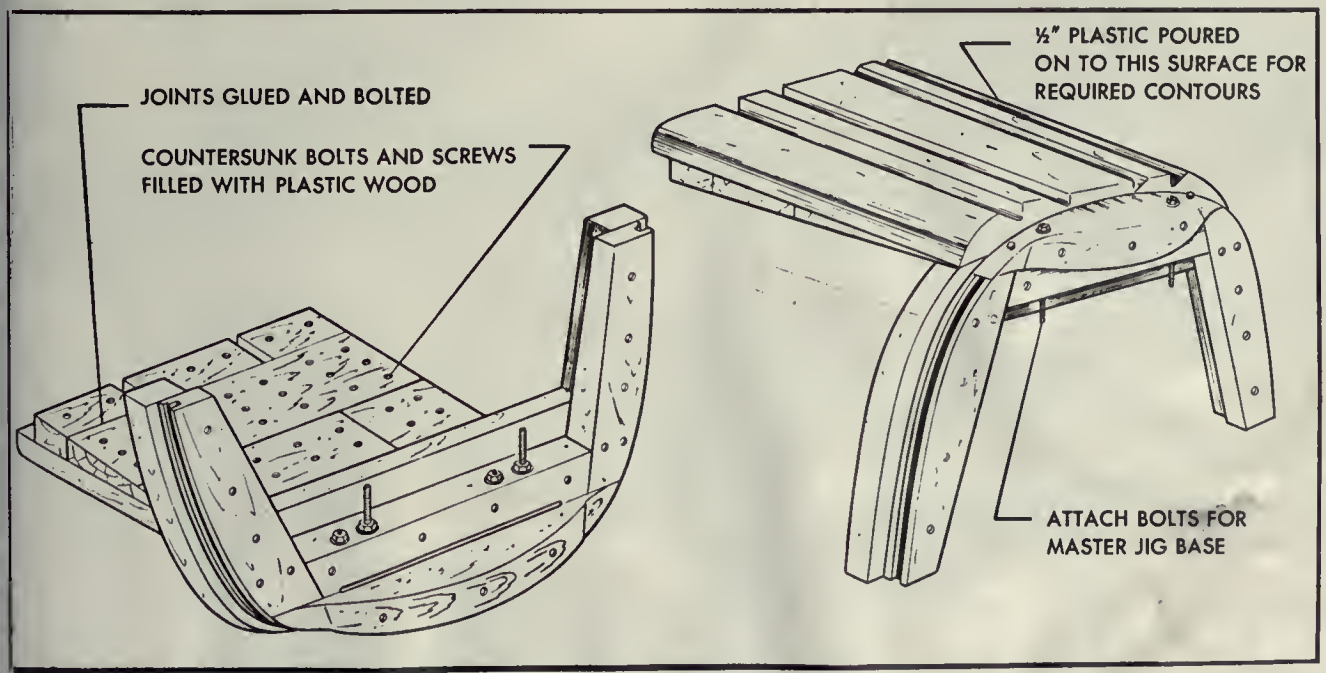
Cast Resins Strengthened by Stable Fillers and Wood Coring Offer Low-Cost, Easily-Formed Tooling Material

aster splash of gunner's enclo-
re frame. Skin, spacer thick-
ss built up by using sheet wax.
ood core then located in plaster

stay in place, were used in fabricating the wood core (below). This core is made roughly to contour leaving a 0.50″ ± .250 dimension for the plastics which forms a natural bond to the wood upon curing. After locating the core in the plaster splash and boxing in the open sections, the plastics mix was carefully poured and allowed to set for 8 hr before curing to allow trapped air bubbles to be released. After curing, all exposed wood surfaces were covered with the same plastics mix and cured with the aid of infra-red lamps. This was done in order to cut to a minimum any future moisture absorption which has so affected stability of plaster and mahogany masters. Provisions have been made, on future masters, to cast a complete plastics case over the entire model.

Difficulty was encountered in that, especially in long

(*Continued on page* 103)



Core used in master jig for frame is made of waterproof plywood and pre-dried, straight-grained sugar pine

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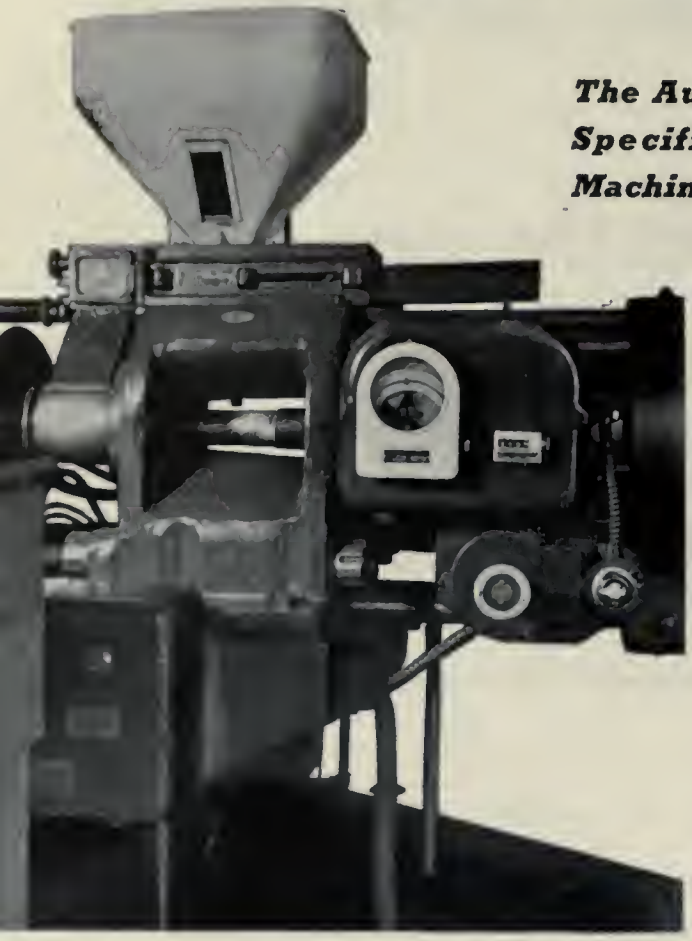
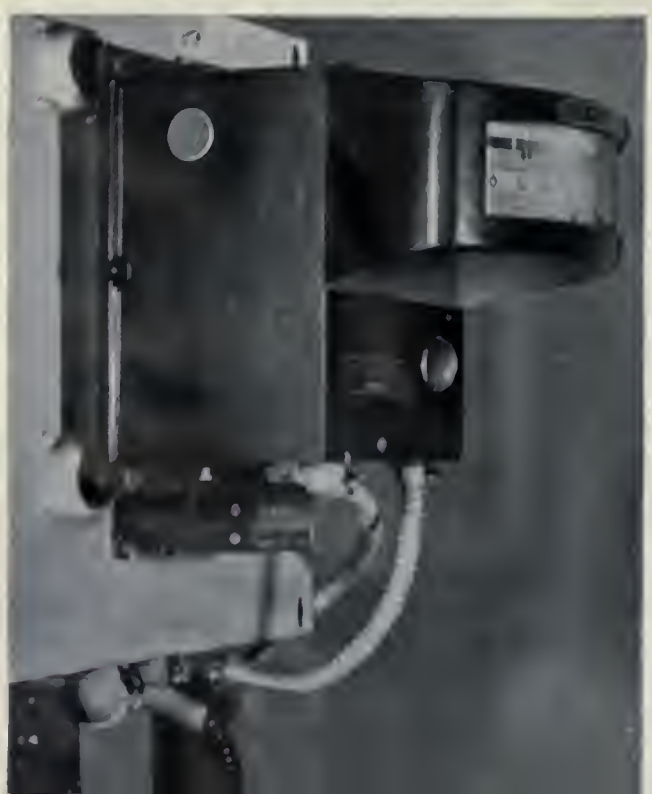


Fig. 1. Injection molding machine improved by Boonton through built-in electric cycle counter in full view of the operator



The Author Offers Manufacturers Some Specific Suggestions for Improving Machinery to Meet Present-Day Needs

By Gordon B. Sayre
Chief Engineer, Boonton Molding Co.

THIS is no blanket condemnation of molding machines. Some of the newest types are excellently conceived and well developed. They do a fine job.

This is, however, an attempt to call to the attention of the molding machine manufacturer the fact that if real plastics molding advancement is to be achieved, it will to a great degree come from the experience gained in wartime and put to the greatest good in peacetime.

Today, many of the machines in molding shops, like Topsy, "just growed." They are hung with gadgets here, improvements there, and other things obviously not part of the original design—everywhere. It is apparent that there has been considerable improvising, and where such is the case, evidence shows that the machines employed are not doing all that is required of them.

There is an old axiom that a carpenter is only as good as his tools. We can modernize that by saying a molder is no better than his machines—even if, like the ingenious carpenter, he has to improvise to get his equipment exactly the way he wants it to be.

Paradoxically, manufacturers of molding equipment in some respects are falling behind the rapid developments taking place in plastics materials, so that as these new materials are created, their full benefits are apt to be lost until more adequate machinery becomes available to handle them. Obviously, a situation such as this demands attention, and if real progress is to be made in the molding of plastics, then there will have to be a re-valuation of existing equipment in the light both of present needs and those of immediate and foreseeable future. This becomes all the more necessary because war production has been demanding closely-held dimensions which are either extremely difficult or impossible to attain with much of the existing machinery. As a result, the molder has had to create his own means of achieving the desired and required results in his products. Naturally, much of this better type molding will be a prerequisite of post-war products.

In an endeavor to retain for the benefit of peacetime use the experience gained under the stress of wartime production, the author will in the following paragraphs discuss what his company did to meet its production schedules. It is hoped that this experience will serve as a guide to the development of better and more feasible

Fig. 2. Placing delicate controls on injection molding machines with rubber shock mounts shields them from operating vibration

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Fig. 3 (above). For semi-automatic compression molding of small, multi-cavity molds, Boonton developed press with floating push-back. Press in Fig. 4 (below) will make hard preforms up to 2 lb and 5" in diameter for heating such materials as 3510, 926

molding production machinery and accessory equipment.

Let us first consider the hydraulic presses now available for compression molding. Inquiry by the author showed the basic design of most of these has not changed in the past 50 years. They were built originally to squeeze oil out of cottonseed, and for other applications in which there is no need for precision.

These presses are built around the vertical ram and cylinder. The fixed platen is attached to the top of the ram. The position of the movable platen, when the press is closed, depends upon the alignment of ram and cylinder. The platens may be off in relation to each other and not parallel. Such presses may be suitable for single-cavity molds, but are inadequate when more than one cavity must be filled.

Designing a New Press

The author's company had to design a new press in order to obtain satisfactory results with small multi-cavity molds. The distinctive feature of this new press is the flatness of its platens—the movable platen riding up and down the strain rods on tightly-fitted bushings. The ram, which simply pushes the platen up and is not firmly fixed to it, is given a freedom of sidewise motion of ⅛", so that it exerts no sidewise action upon the press itself. The up-and-down freedom of the ram is 1/32", so there can be no binding action between it and the platen.

The cylinder is self-contained with internal packing, chrome-plated rubbing parts and stainless steel ram. The design permits floating pushback so the press can be operated semi-automatically (Fig. 3). The mold in this press was a former hand mold but is now mounted permanently, with the molded parts ejected by knockout bars resting on adjustable stops clamped to the strain rods. The daylight of this press is 24" with a stroke of 10". It has a 70 ton capacity with a push back of 4½ tons. The upper platen is adjustable for alignment of molds and the chrome nickel steel strain rods afford maximum clearance.

The first press made of this design had a capacity of 20 tons. There are now 40 presses in the plant, with capacities up to 70 tons. Since many war items require a precision as close as .001", even in the vertical dimension, the need for this new design is obvious.

Other Models

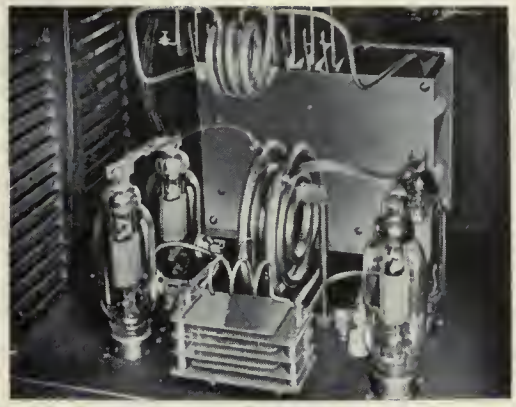
This press has also been designed with stationary center platens and cylinders both top and bottom, adapted to a number of purposes such as self-contained transfer molding and the producing of large canvas preforms. The press shown in Fig. 4 will make hard preforms of such materials as 3510, 926, etc., up to 2 lb and 5" diameter, such preforms being desirable for electronic heating. Another design of this press has adjustable side rams which can be applied as accessories to one up to three sides for very complicated moldings in high production. Knockout devices can also be attached to facilitate mold stripping in some cases. The side rams can be used for transfer molding where the transfer pot is split on the parting line. Two cavities can be transferred in one mold separately, by using a horizontal cylinder on each side.

This development possesses a significance beyond the mere production of a new device. It shows that press manufacturers should study the needs of the molding trade and to design and produce presses to meet these requirements. Thus far the molder has had to develop his own.

The plastics industry has used the same type of compression molding press used in other industries where

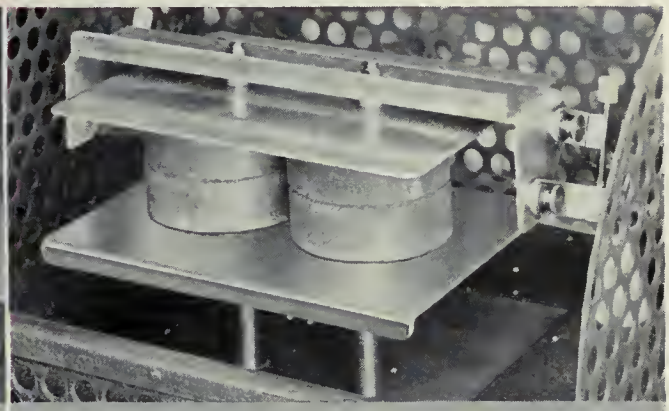
(Continued on page 116)

FASTER, BETTER MOLDING with Airtronics PREHEATERS Insured by Advanced Design



The symmetry, simplicity and rugged construction of the AIRTRONICS Model CB Oscillator and power transmission elements are shown above.

AIRTRONICS Model CB Control Panel. Adjustment of power output and preheating time made in a few seconds with Set-up, Power and Timer Controls. No special training necessary.



AIRTRONICS Model CB Self-Aligning output electrodes. Safety switch turns off power when hood is raised.

Developed expressly for plastics molders—who needed electronic preheating equipment that was more dependable, more versatile and easier to operate—AIRTRONICS units have established enviable *records throughout the plastics industry. Exclusive features of AIRTRONICS design are responsible for* these *higher standards of performance...*

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What Price Performance?

By Frederick Z. Pearson

Manager, Plastics Division
Lyon Metal Products, Inc.

System Based on Maximum Performance vs Cost per Unit Volume of Finished Product Facilitates Selection of Raw Materials

JUST where do plastics stand in a cost-vs-performance comparison with other industrial raw materials? This has been a moot point for a long time, and little progress has been made in developing standard methods of comparison. Only through trial and error has industry found its way through the maze of materials and processes and been able to settle on certain of them as being desirable. This writer will attempt to develop here the nucleus of a system which could be elaborated upon and enlarged to provide a truly reliable tool for comparing plastics with each other, and with an extensive variety of other materials.

At the outset, it should be made clear that the emphasis is entirely on FACTS, for which there is no substitute. Dreams and possibilities have no place in a practical plan. In addition, costs must be within reason. Materials and methods used must provide an attractive finish of lasting quality, permit fulfillment of the major functions of the item in an efficient manner, must contribute reliability, and all at the lowest cost. The question at all times must be: "What price performance?"

Performance varies with the product under consideration. A refrigerator must preserve and store foods at the price of minimum first cost, running expense and maintenance.

A radio must give entertainment and instruction, and be reliable at minimum cost, maintenance and expense. A piece of luggage must provide maximum storage volume under adequate protection and maximum durability, at minimum weight and cost.

Performance is highly variable in different products, but maximum *permanence* at minimum cost is a universal requirement. The best way to bring the problem nearer solution is to make a list of all possible properties required in the product under consideration, and then check against this list the characteristics and costs of the available raw materials.

The accompanying chart is the writer's suggestion as to how an insight in cost-performance relationships may be obtained. It is principally intended to furnish a basic *pattern*, as undoubtedly many readers will want to add further columns, indicating characteristics emphasized in their line of business. Also, there are many different approaches possible to the *interpretation* of this type of data, and you will find some remarks in this respect, following the next few paragraphs, describing our present chart.

In Column 1, headed Materials, we have listed a group of major industrial materials. Obviously, considerable extension is possible.

Column 2 gives the cost per lb of each of these materials as delivered to the fabricator, or as mixed and readied for fabrication by him.

Column 3 gives the specific gravity of each material, the and water.

(*Continued on page* 118)

Performance—Cost Comparator	2 Cost (¢) per Lb	3 Specific Gravity	4 Manufacturing Conversion Factor	5 Cost per Cu In	6 Flexural Strength (10^{-3})	7 Modulus of Elasticity (10^{-6})	8 Impact Strength, Ft Lb per In/Notch	9 Water Absorption in 24 Hr (%)	10 Resistance to Continuous Heat	11 Surface Hardness (Rockwell M Scale)	12 Dielectric Strength (V/Mil-1/8" Thick)
Steel sheet, deep drawn, paint finish	3	7.80	3	70	80	29.00	29	3.0	500	120	*
Aluminum sheet, deep drawn, finished	20	2.80	2.5	141	40	10.50	20	1.0	500	108	*
Magnesium—cast—finished	27	1.80	3	144	30	6.50	20	2.0	500	100	*
Stainless steel—deep drawn	36	7.80	3	840	120	28.00	25	0.1	600	120	*
Masonite hardboard, synthetic enamel	5	1.18	4	23.6	12	0.70	3	10.0	230	80	125
Plywood-mahogany—lacquered	7	0.80	4	22.2	19.3	1.64	4	10.0	180	80	50
Plywood—urea-impregnated	9	0.80	4	28.6	19	1.50	4	5.0	230	95	100
Compreg—phenol-impregnated	12	1.40	4	67	36	3.60	6	7.0	230	95	115
Grade X-laminated—paper base	11	1.35	2	29.6	16.5	1.70	2.5	4.6	230	95	700
Grade C-laminated—cloth base	25	1.35	2	67	15	0.90	15	5.6	230	95	375
Creped paper base-phenolics	30	1.40	1.5	63	17.5	1.70	1.5	4.6	230	95	650
Creped cloth base-phenolics	60	1.40	1.5	126	16.5	0.90	6	4.6	230	95	375
Cloth base—no pressure resin	35	1.40	1.6	78	20	1.00	15	1.8	230	95	300
Glass base—no pressure resin	135	1.70	1.6	370	33	1.90	15	0.4	480	108	550
Grade C laminate—post-formed	60	1.40	1.5	125	20	0.90	15	4.6	230	95	375
Cord-filled phenol molding compound	30	1.40	1.7	72	12.5	2.00	7.2	1.4	230	98	300
Sisal-phenolic laminate	40	1.35	2	107	20	0.50	12	8.0	230	95	350
Vinylidene chloride	40	1.73	1.5	104	16	0.35	6	0.1	180	57.5	350
Polystyrene—molding material	25	1.06	1.5	40	13.5	0.35	0.4	0.1	170	82.5	600
Cellulose acetate-butyrate	35	1.30	1.5	59	10	0.35	8	2.0	180	48	325

* Conductor

These people buy a battleship —every week!

Meet John S——— and Mary D———

John works at an electronics plant on Long Island, and makes $85 a week. Almost 16% of it goes into War Bonds.

Mary has been driving rivets into the hide of one bomber after another out at an airplane plant on the West Coast. She makes $55 a week, and puts 14% of it into War Bonds.

John and Mary are typical of more than 27 million Americans on the Payroll Savings Plan who, every single month, put a half a BILLION dollars into War Bonds. That's enough to buy one of those hundred-million-dollar battleships every week, with enough money for an aircraft carrier and three or four cruisers left over.

In addition, John and Mary and the other people on the Payroll Plan have been among the biggest buyers of *extra* Bonds in every War Loan Drive.

When you come to figure out the total job that John and Mary have done, it's a little staggering.

They've made the Payroll Savings Plan the backbone of the whole War Bond-selling program.

They've helped keep prices down and lick inflation.

They've financed a good share of our war effort all by themselves, and they've tucked away billions of dollars in savings that are going to come in mighty handy for both them and their country later on.

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Plastics at Work

exten ion spring is a mechanical device
o ing a te sile force to control the move-
of or transfer motion to adjacent parts.
of "Pl xigla " permits overall observation

Tailor's cloth marker, fitted with saw-toothed swivelling wheel, is molded of Tennessee Eastman's "Tenite" by Columbus Plastic Products Co.

This unshorn sheepskin is plasticized to resemble genuine lynx. Nominal cost is said to be a feature. Plasticizing process developed by Jose Calvo, Minneapolis scientist. (Acme Photograph

PLASTICS AT WORK

Both the raincoat and the tire are products of the Firestone Tire & Rubber Co. The tire is a heat-tempered all-plastics type, while the coat is made of "Velon", a thermoplastic fabric

[illegible] & Haas's "Plexiglas" or du Pont's [illegible] for [illegible] tire framework, this Crystal [illegible] Company display counter mirror combines a large degree of modernity and utility

Low pressure laminating of Bakelite Corp.'s "Bakelite" phenolic resins has made possible the fabrication of curved sections such as are designed into this serving tray

Merchandising PLASTICS PRODUCTS

By Joseph S. Stein

Sales Manager, Chain Store Division
Columbia Protektosite

"Be not the first by whom the new are tried,
Nor yet the last to lay the old aside."

ALEXANDER Pope's immortal lines sum up in the fewest possible words the secret of many outstanding businesses, especially the rules of success underlying the country's retail chain stores. These stores realize that John Q. Public is an odd person in his buying habits. He can't afford to be a guinea pig. Neither does he want to be a "have not"; he's happiest just keeping up with the Joneses.

This concept of the consumer has considerable bearing on the future of the plastics industry. The history of the industry has closely paralleled that of the automotive field. At the turn of the century automobiles were custom built playthings for the wealthy. Then, as certain standards of design and manufacture emerged, prices dropped and cars came within the budget of a larger section of the American public, becoming the vital necessity we know today. So with plastics, after a period of "dream applications" and novel uses, they are no longer among the "world of tomorrow" exhibits, but mass products. Their future depends on ability to *combine mass production with utility and quality.* Given an industry that is capable of mass-producing consumer merchandise, and a vast syndicate store system capable of mass dis-

A wide variety of plastics products can be offered within the price range of merchandise featured by variety stores

Eye-Appeal Coupled with Other Advantages Promise Large Sales Through Chain Store Promotion

Effective and attractive containers can be developed for chain store merchandise, despite the fact that the low price range decidedly limits what can be expended on fancy packaging

distribution to the ultimate consumer, it is necessary to establish common bond between these factors to make them mutually beneficial. What do plastics offer to the chain store? The success of syndicate store selling is *mass promotion*, not only in one store but simultaneously in all stores. Since 5-and-10 chain stores' wares comprise numerous modestly-priced items, small units of sales must be vastly multiplied to make any item really profitable and indispensable. Plastics are ideally suited to meet this basic requisite, because they lend themselves so ideally to the mass production of modestly-priced consumer goods.

Consider color. Chain store selling is not essentially based on product demand created by advertising. Product display on the chain store counter is designed to entice the shopper into looking and helping himself. There is usually no verbal sales persuasion to influence the purchase. The sale is almost entirely consummated by self-selling. Color, therefore, is an important product asset. It helps not only to associate product use in the consumer's mind but also to attract initial attention. Here again is a strong point in favor of plastics.

One of the bugaboos of chain store business is loss through breakage, soiling and fading. Again plastics are a definite answer to the chain stores' problems in keeping merchandise on display neat, clean and saleable, thus reducing losses to a minimum, being washable and non-fading. Now, what are some of the negative angles?

Most negative reactions to plastics which chain store buyers may have had have not been the fault of the material itself. Rather, it has been the result of a failure on the part of the plastics molding industry accurately and intelligently to measure the market they have wished to sell and plan their product for that market. Chain store buyers make mistakes too; they wouldn't be human if they didn't. But they are smart enough not to make the same mistake twice. Therefore, when a failure to research the ultimate product use and a misuse of plastics result in improper products that beget unsold merchandise, consumer complaints and returns, buyers become wary of plastics. The responsibility for creating a good impression for plastics products and the plastics industry rests in the hands of the molders, not the retailers.

One classic example of poor planning in the introduction of a plastics product was that of an all-plastics tea strainer which appeared on the market some time ago. The product was attractive and the item was definitely saleable—due chiefly to the fact that metal was unavailable. But the designer didn't make the strainer large enough to properly bridge a teacup, and the molder used a thermoplastic rather than a thermosetting material. As a result, the strainer became limp when hot tea was poured into it! True, the mistake was eventually discovered and an improved strainer was placed on the market, but the damage had been done. Women are notoriously sensitive to the mistakes they make, and today you can't give a good plastic tea strainer to many women who unfortunately bought the first product. In this instance the consumer did not blame the manufacturer who made the strainer; they not only blamed the stores from whom they purchased the strainer but they condemned plastics as a reliable material for kitchen ware. A mistake? Yes—but a new industry can't afford too many mistakes at a time when it is trying to win the support of the consumer.

There are also less-apparent pitfalls which the molders and sellers of plastics must avoid. As an illustration of little things that cause big annoyances, take the case of the white and pastel lipstick cases. Pretty to look at while they were new, these cases soon became messy and were regarded with distaste by their users. The kind of

(*Continued on page* 113)

In a typical chain store layout, where the customer sees and handles all merchandise, the need for eye-appeal and resistance to damage, soiling and fading is amply met by plastics products

Plastics chromatic harmonica consisting of 14 parts, as against 159 for imported metal variety

There's Music in Plastics!

All-Plastics Harmonica, Featuring Polystyrene, Has Fewer Parts, and Better Tone Than Metal Counterpart

By Finn H. Magnus

Vice-President, Charge of Plastics Division, Harmonic Reed Corp.

Five-part Magnus harmonica. Note reed plate construction

DEVELOPMENT of the all-plastics harmonica has created a few innovations, both from the musical and productive standpoint. In regard to the former, it is practically agreed that better tonal quality can be obtained from the new instrument as a result of the use of a new reed design which can be made only from a plastics. For this purpose we chose polystyrene—a material which has permitted us to produce an instrument which has a fair chance of obviating the necessity of going abroad for the greater part of the supply of harmonicas required to fill domestic needs.

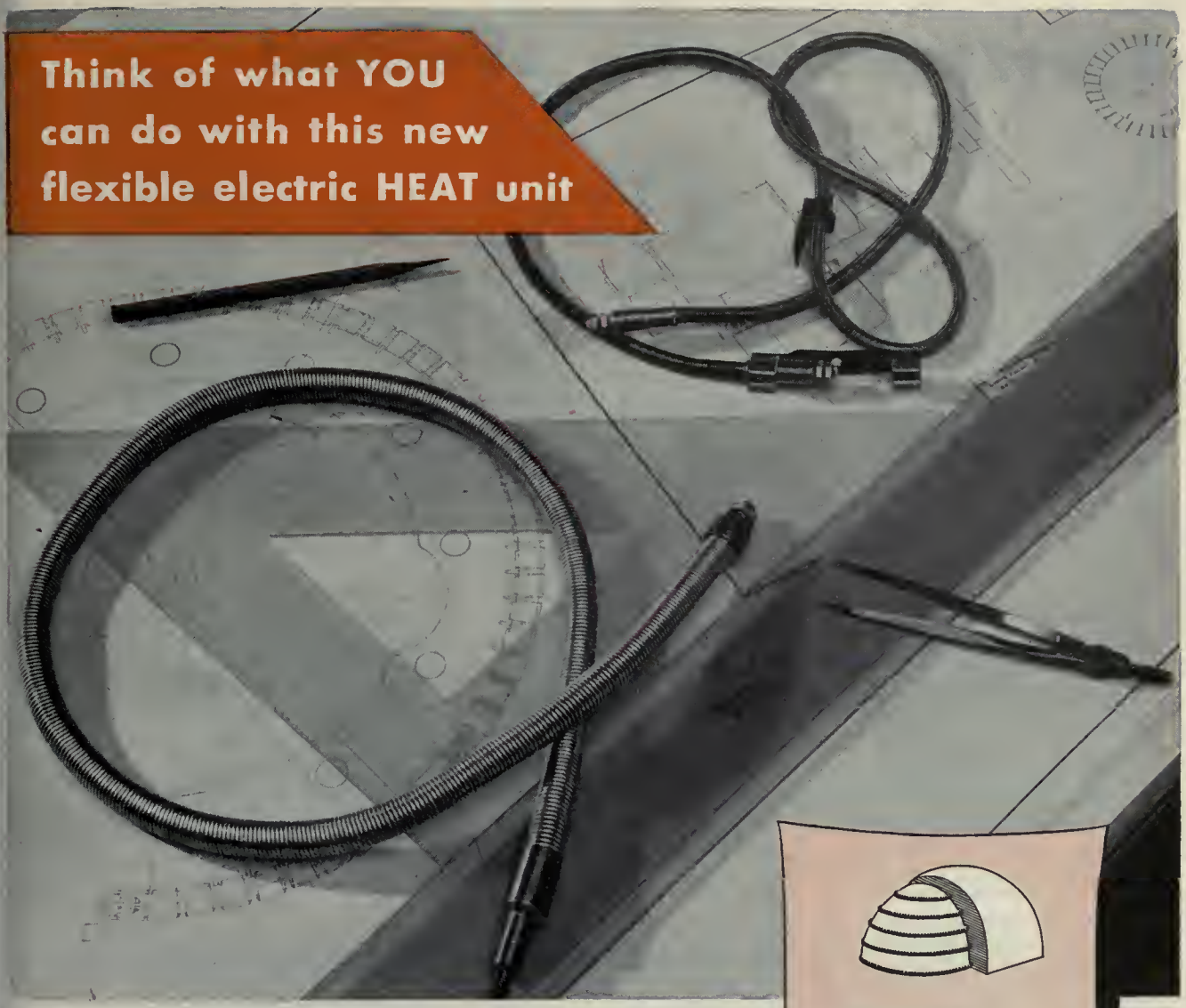
Germany and Japan formerly supplied the bulk of the harmonicas used in this country. U. S. Chamber of Commerce statistics show that 9,500,000 were imported in 1936; 8,500,000 in 1938; and 7,900,000 in 1939. Limited quantities of the metal type harmonicas were produced in this country in the past, but the American industry was unable to compete with the foreign product due to the higher cost of production over here.

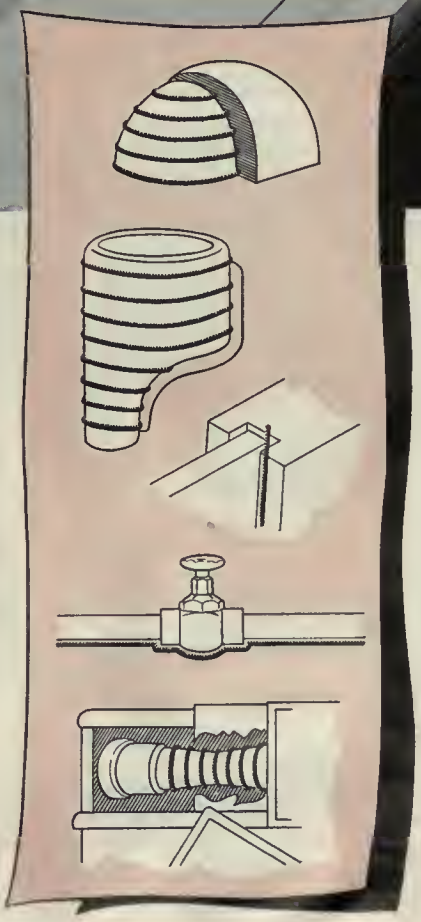
The all-plastics harmonica eliminates much of this production and cost difficulty. For one thing, it has only five parts, and is assembled by a rapid plastics welding operation. It weighs 29 gm, as contrasted to 57 in the metal harmonica. It can be washed in soap and water without deleterious effect to composition or tonal quality, and it can withstand cold and heat.

The clue to the excellent tone of the instrument is in the polystyrene plate which contains integrally molded reeds. The plastics reed has proved to be more resilient

(*Continued on page* 104)

Think of what YOU can do with this new flexible electric HEAT unit





● You can coil it around pipes, valves, nozzles, cylinders. You can spiral it around molds. You can fit it to odd contours or zig-zag it on flat surfaces.

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Acrylics Can Be Welded

By M. L. Stephen

First Details of the Recently-Announced Process of Heat-Bonding Acrylics, and Methods and Techniques By Which It May Be Extended to All Types of Joints

THE implications of the new process of heat-welding acrylics, recently developed by Rohm & Haas, are already making themselves evident. Although the company, in its own exposition of the technique, covers the application of the process only to simple butt-welding of straight aligned sheets, it is apparent that the same principle could be made to apply to other types of joints by designing appropriately contoured heating elements and developing jigs for exerting pressures in the required directions. This discussion points the way to the use of the new method beyond the limit of its initial application.

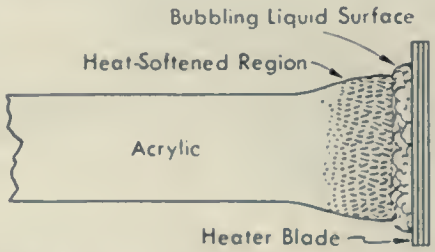

Fig. 1. When placed in contact with extremely hot metal surface, methyl methacrylate semi-liquefies as it de-polymerizes

Cementing—the principal method hitherto employed for the joining of methacrylates—has always involved a lengthy time interval between completion of the bonding operation and the attainment of full strength by the cemented joint. Regardless of solvent used, the bond does not come to full strength in less than 24 to 48 hr and, in the case of some acrylics, in not less than 10 days.

However, the new process consists simply of the application of heat and pressure without the intervention of any solvent and produces a joint which, in addition to being transparent, has nearly the strength of the material itself. The interval before attainment of full strength by the joint is reduced to practically nil, for, it is claimed, full strength is reached immediately on cooling of the joint. In addition, bonding routine is reduced from many minutes to a few seconds.

The theory of the new process is that contact with an extremely hot metal surface de-polymerizes methyl methacrylate into vaporous monomer. The heat-contacted surface of the material semi-liquefies and softens as the polymer disintegrates. (Fig. 1.) If two surfaces in this condition are brought into intimate contact with each other under proper pressure—comparatively low pressure—and remain in that relationship until cooling has been completed, a strong joint is the result.

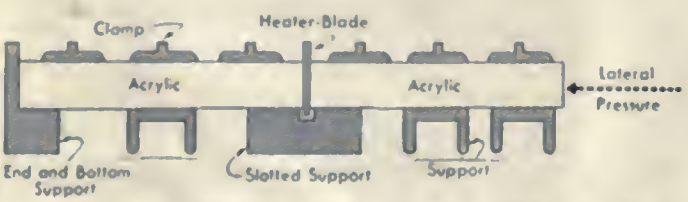

Fig. 2. Recommended set-up for heating operation on straight butt weld. Pressure need be applied from only one direction

Equipment for the process is simple. The procedure is even simpler. A heating element, a means of providing pressures and a group of clamps constitutes the required apparatus. Fig. 2 shows the recommended set-up. As can be seen from the drawing, pressure for closing the joint-edges against the heater-blade need be applied from only one direction. Screw pressure would seem to be the most easily set up and manipulable type, although other means such as levers, wedges or hydraulic jacks may be used. Buckling of the sheets under pressure is prevented by the indicated clamps.

Although a hot plate, a coil heater or even a heating element containing heated oil or mercury vapor can be used in the welding process, the heating provision that has been found most satisfactory is a simple resistance heater unit consisting of a heater-blade of stainless steel and a rheostat for temperature control. The heater-strip should be wide enough to overlap the upper and lower edges of the joint and long enough to allow about 2" of heater-strip beyond each end of the joint. The thickness of the heater steel should be about $\frac{1}{8}$" for most operations. The blade must be kept straight and taut to provide as unvarying a surface as possible for contact with the edges of the sheets.

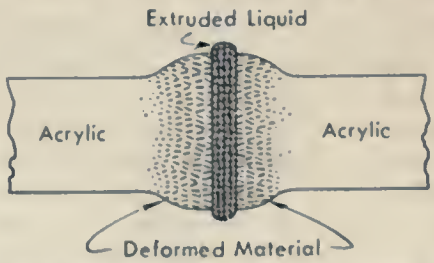

Fig. 3. Upon application of lateral bonding pressure, acrylic softens, forming rounded welt in area adjacent to the joint

Since the temperatures required are high, the voltage source of the heater unit would normally be the secondary of a transformer. The voltage and amperage needed to obtain the required temperature will vary with the size and shape of the heater blade, which, of course, means the dimensions and shape of the joint. For a blade measuring 30"×2"×0.06", the company recommends a heavy-duty transformer operating on a 220-v primary with a secondary output of 450 amp at 3 v.

The heater-blade temperature that provides most efficient operation and produces best results has been found to be 350° C (660° F). A blade cooler than 300° C does not permit sufficient de-polymerization for liquefying the

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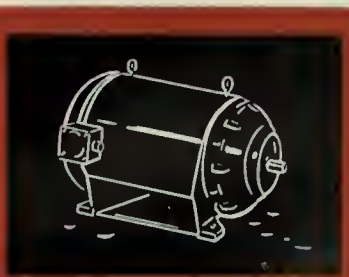

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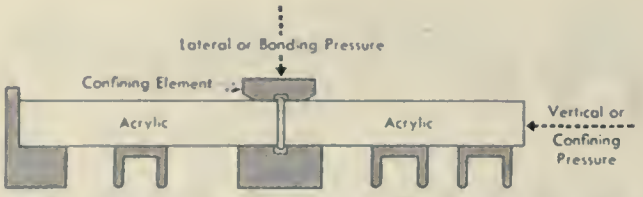

Fig. 4. Set-up for application of bonding and confining pressure following the heating operation. The confining elements are slotted to permit escape of monomer vapor from the joint

surface of the joint, while, with the blade at a temperature higher than 400° C, vaporization of the monomer is so rapid that what liquid is left is insufficient to form a bond. A pyrometer check should be kept on the heater-blade.

With the set-up described, the welding technique presents no handling difficulties. The sheets to be joined should be finished smooth and should fit precisely. They should be held rigidly aligned by clamps set as close to the edges as possible. Since the heated material next to the joint becomes soft, the sheets can not be accurately aligned under pressure unless properly supported. (Fig. 2).

After alignment, the hot heater-blade is placed between the two edges of the sheet, which are then pressed against it. The pressure and the ensuing softening of the edges establish perfect contact along the entire length of the blade. Then pressure is released so that the liquefied surface is not extruded as it liquefies. The edges of the sheets should now be boiling and smoking slightly. Ordinarily, about 30 sec are required to produce the bubbling-smoking condition, but, in any case, the joint should be heated only long enough to provide perfect contact between heater-blade and sheet edges and to attain the required state. Heating longer than necessary softens the material adjacent to the joint to too great a depth and causes the edges to deform easily under the bonding pressure which is later applied.

When the bubbling condition has been reached, the heater-blade is withdrawn and the joint-edges are immediately brought together under a spring or dead-weight pressure of about 250 psi, and the pressure is maintained until the entire joint has cooled below the forming temperature of the acrylic. Since the material immediately adjacent to the joint is in a softened state, the pressure will deform it so that the material pushes out in a rounded bead or welt, as in Fig. 3. The depth of the softening inside the joint-edges depends mainly on the degree of heat, but in general it would be about 3/16". Height of the bead or welt along the sides of the joint would ordinarily depend on degree of lateral bonding pressure.

The material "remembers" its original state. Therefore, if pressure is not maintained until the joint is cool well beyond forming temperature, the deformed part of the acrylic will tend to revert to status quo ante, tearing a part of the bond in the process. Premature release of pressure causes a decrease of from 10 to 15% in the tensile strength of the joint.

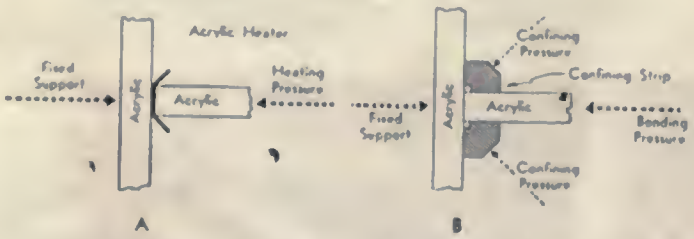

Fig. 5. Adapting the acrylic welding process to the T-joint. At left, note the position of the heating element. Right, pressure exerted from two directions at right angles to each other

Even if pressure has been maintained until the joint is cool, a problem still remains in the welts along both sides of the joint. If the welt is ground off and the joint is reheated for forming or for other operations on the acrylic piece, the remaining material at the joint shrinks back and a groove is formed along the line of the joint. (According to Steiner Manufacturing Co., Brooklyn, N. Y., plastics fabricator whose specialty is acrylics, the groove problem does not present itself in the case of acrylic parts which are not to be further subjected to heat operations. In a number of samples which this company made up and in which the new welding process was used for the bonding of parts, they simply ground off the welts to align the joint with the surfaces of the material and polished the joint. The result was entirely satisfactory and the loss of tensile strength negligible.

The solution of the problem of maintaining tensile strength and of preventing grooving on reheating of the material is found in confining the joint above and below the weld so that no welts appear when the joint cools. The method of accomplishing this is shown in Fig. 4. Immediately after heating of the joint, lateral or bonding

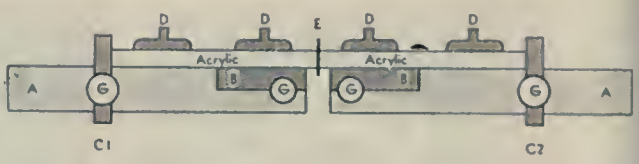

Fig. 6. Table (A) to facilitate welding: Clamps (D) hold acrylic against heating element (E) to prevent buckling under pressure when gates (C1, C2) tightened by (G). (B) are sliding supports

pressure is applied first. Then, with both the undersides and topsides of the joint in contact with rigid polished surfaces, vertical or confining pressure is applied against the welts. It will be noticed in Fig. 4 that the confining elements are slotted to provide a channel for escape of

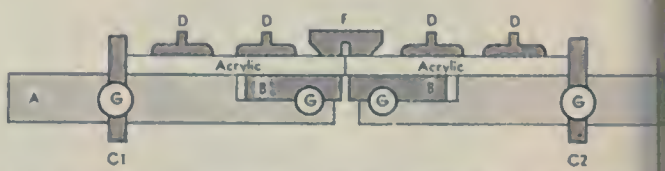

Fig. 7. Set-up for applying confining pressure (F) on welts along weld. Slides (B) move in to support welts. C2 tightened as lateral bonding pressure applied. Joint then left to cool

the monomer vapor from the joint. With pressures maintained, the joint is allowed to cool. With this procedure, not only is the joint ready for polishing immediately, but distortion is at a minimum and strength loss under subsequent reheating of the joint has been greatly reduced. When confining pressure is applied, with a slot in the confining strip to permit escape of the monomer vapor, no bead is left that requires subsequent reduction by planing, grinding or sanding.

The joint should be allowed to cool slowly, for it is responsive to all the internal stresses that the acrylic itself will experience under forced or over-rapid cooling. If cooling of an acrylic in a heat-expanded state is too rapid, the surface of the plastic becomes rigid and forms a shell around the still-hot interior. Shrinkage of the interior material back to a normal state is retarded and severe internal stresses are set up. Those stresses naturally affect the welded joint, making it brittle and subject to crazing.

As far as proper slow cooling is concerned, the confined

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joint has a distinct advantage over the unconfined one in the fact that, under confinement, heat dissipation is much more gradual and a practically stressless joint is produced. (The fabricator mentioned above has found that, at room temperature and depending upon the thickness of the material, cooling of an unconfined joint is completed in from 10 to 20 mins.)

It is, of course, necessary to keep both the joint edges and the heater-blade absolutely clean in order to avoid dirt in the joint. If this precaution is taken, the joint will be very nearly invisible.

It was noted earlier that, while Rohm & Haas has confined the exposition of its welding development to the butt-welding of straight sheets, the principle could be applicable to other forms of joint, as, for example, the T-joint. Modifications of heater-blade and confining strip construction for this type of joint are suggested in Fig. 5. If the heater-blade were of perfectly straight cross-section, its upper and lower overlapping edges would de-polymerize areas on the vertical sheet above and below that which is required. This is obviated by designing the heater-blade so that its overlaps are not in contact with the sheets at all, as in Fig. 5a. When lateral bonding pressure is applied to the heated joint, welts will be thrown up as usual, but in this case they will not be in the same plane but at right angles to each other. The confining elements of Fig. 5b are designed accordingly. The direction of confining is such that both the welts at right angles to each other receive confining pressure.

The whole acrylic welding operation can be facilitated by the table set-up suggested in Fig. 6, in which parts A are the main table plate. Parts B are slideable toward the middle by means of gear or frictional engagements actuated by the round knob shown. Parts C are moveable gates, similar to those found on a circular saw table. In operation, C1 is set and then remains fixed. Lateral pressure is then applied to C2 to press the acrylic sheet edges against heater-blade E. Parts D are clamps to hold the sheets down against buckling under pressure.

The set-up in Fig. 7 is for application of confining pressure on the welts along the weld. It is designed to reduce to a minimum the interval between completion of the heating operation and application of bonding and confining pressures. As soon as the heater-blade has been withdrawn at the end of the heating operation, sliding plates B are moved in to provide support under the welts along the underside of the joint and confining strip F is let down to contact the welts on the upper surface. Gate C2 is loosened and lateral bonding pressure is applied to it. With the pressure maintained, C2 is tightened to the table, after which the lateral pressure can be removed. Immediately thereafter, vertical confining pressure is applied to confining element F and the joint is left to cool without further attention. Letters G represent knurled knobs.

In dealing with tolerances in the adoption of this process, it might be pointed out that the heat welding operation occasions a dimensional loss which must be provided for in advance. This loss, which, of course, is in only one plane, is caused by the slight collapse of the heat-softened joint-edges toward each other as lateral bonding pressure is applied. The welts thrown up by the pressure are the evidence of this collapse. The linear measurement of the collapse is the extent of the dimensional loss. Confining pressure for reduction of the welts does not make up for this loss, since the lateral bonding pressure, which is applied before the confining pressure, is maintained.

Dimensional loss must be taken into account before the operation is begun—the allowance determined experimentally for any joint to be put into work, since the process is too new for development of standard data. END

CAPITAL Report

By Arnold Kruckman

Plastics' Washington Correspondent

IN a conference early in October the new chairman of the WPB, J. A. Krug, made a statement which is very important to the plastics industry:

"Lest I leave the impression that everything is fine, I want to show you a table which reveals the status of the most critical war programs. It indicates, at this time, the beginning of the last quarter of 1944, the status of most of the war programs for the year to date. These percentages are figures to show the extent (%) to which the program is completed through August:

"Heavy artillery, 58; General purpose and fragmentation bombs, 53; Heavy artillery ammunition, 50; Heavy-heavy trucks, 45; Superbombers, 42; A-26 *Invader*, 27; and Combat loader, cargo and transport vessels, 14.

"These statistics leave little room for complacency." This obviously reveals there is a tremendous war job still ahead of American industry. From England we hear Churchill's opinion and De Gaulle's judgment that the war over there may drag on until Spring. They tell us here the Japanese war may continue for 2 or 3 years. All this means the larger part of the economy must be devoted to making war material and equipment, even if we are over the hump of the most intensive war production. This situation hits the plastics industry both directly and indirectly, for plastics components must be used as part of war equipment, and the chemicals which are the base of plastics must be used in the explosives and other war materials.

Mr. Krug added: "After the defeat of Germany, the entire U. S. economy will change. Today, about 45% of the total production of goods and services goes directly into the war effort. But 6 months after V-E day cutbacks, we estimate that the war's share of the gross national output will drop about one-third."

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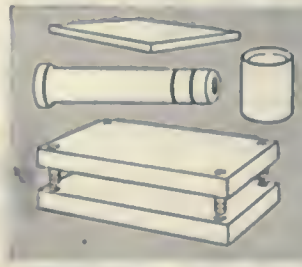

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after V-E day, particularly in relation to the uses in connection with automobiles, refrigerators and washing machines. Late in September the division issued a special warning that it could not "legitimately give the producers of these goods hope for any synthetic finishes, based on phthalic alkyd enamels, now, and *even the collapse of Germany will not guarantee an abundance of these enamels.*" The supply depends almost wholly upon the size of military orders after V-E day. The division is investigating how to acquire frozen and surplus materials owned by the armed services; the whole question of tightened lacquer supplies; the proposed change in the alkyd resin Order, M-139; the increasing scarcity of phenolics and ureas; and the scarcity of butyl alcohol; butyl acetate, toluene and xylol. The Department of Commerce predicts that the post-war foreign market will demand all or more of these finishes than was represented by pre-war export volume. If the present sentiment governs post-war commerce, however, the foreign consumers will get none for at least 2 years.

How to Get Surplus Materials

Here is how you may obtain frozen and surplus plastics materials from the Government: A material may be declared surplus only by the armed services. After such declaration the disposition passes to the Defense Supplies Corp., a subsidiary of the RFC. There are many local offices of the DSC scattered around the country. If you cannot find one handily, ask your bank to inquire of the RFC for the location of the nearest DSC office. The DSC, before disposing, asks the Chemicals Bureau of WPB if there are any end-use restrictions which must continue in the application of the materials. Whoever purchases the materials must comply with any existing restrictions. The DSC will offer the plastics materials, industrial finishes or otherwise, first, to the original manufacturer; second, to manufacturers of the materials in the area where the surplus materials are stored; third, to any manufacturer anywhere in the country; and, fourth, to any persons on the open market with end-use restrictions removed.

Addenda

Department of Commerce reports a commercial enterprise has been successful in India in using horn waste as a raw material for plastics buttons, combs, umbrella handles and similar articles. The waste becomes available in the South India cottage or "home" industry. The Department also reports a wool-like fibre not unlike *Aralac* made from soybean casein, will soon be produced by Drackett Products Co., Cincinnati. The story of cellulose plastics is told in a free, 40-min, 16 mm all-color sound movie, "Careers for Cellulose," which shows Hercules Powder Co.'s technology for making cellulose acetate, nitrocellulose, ethyl cellulose, bases for plastics, lacquers, film, rayon and numerous other articles.

Congressman Fulmer, Arkansas, the Rhodes scholar of this Congress, has introduced HR5279, which would establish a number of forest products pilot plants under the Department of Agriculture. These would include several plants to develop plastic products by experimenting with forest resources.

United States Naval Laboratory and the National Bureau of Standards have jointly produced a plastics binocular that meets all service needs. It has the standard 7x50 Navy body, made of plastics, the materials being thermosetting phenolic molding compounds with a long-fibre asbestos filler. A special 6x42 binocular was developed to take best advantage of the plastics. It is waterproof at 100 ft deep, and resists fungi and corrosion. END

plastics overseas

By KENNETH R. PORTER
Plastics' London Correspondent

G. Haim

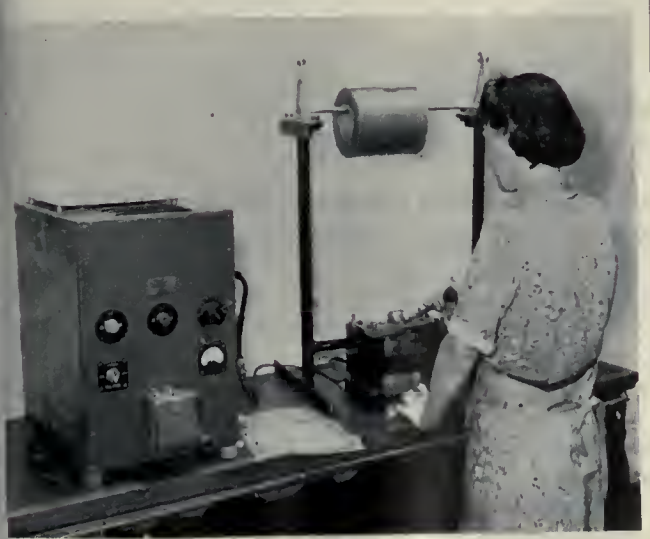
That schools for teaching plastics welding are likely to make their appearance in England soon is the prediction advanced by G. Haim, chief chemist of the ARC Manufacturing Co., Ltd., London, in an interview with the writer. He also points to the possible post-war training of demobilized men for this new profession. The courses would include established methods already perfected both for hot gas or air welding and high frequency spot and seam welding, instruction of which would be conducted in specially organized plastics welding schools.

One of the welding processes to be taught in these schools is similar to the oxyacetylene welding technique in which the torch employs a stream of hot air or gas instead of a small jet of flame. Temperature of the gas is approximately 250° C.

Joining pipes is considered as the most important application of the process, although lap, butt and fillet welds can be satisfactorily made. As the diameter of extruded plastics pipes is limited, a system of fabrication must be used to produce larger sections.

This is done by cutting polyvinyl chloride sheets to proper dimensions and bending them to shape after heating the material in a special tunnel oven. These sections are then welded along the longitudinal seam. Their final shape is achieved by the use of special metal forms over which the rough pipe is placed for reheating to relieve stresses through an annealing process.

There are many applications of the new technique, including the welding of buckets, tanks and tank liners, especially those used in the handling of chemicals and acids. Obviously many household articles could be produced by the same method, substituting plastics for metals. Some of these items can be formed from sheet materials making unnecessary the employment of expensive metal molds.



High-frequency welding of polyvinyl chloride moisture-proof bags on fixed jig; welder's apron high-frequency seam-welded

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Method used for hot gas welding of polyethylene pipe

If the welding of a comparatively small number of parts or components is the aim, hot gas welding will provide the answer. Where mass production, however, is intended, high frequency welding should be preferable. The Germans are restricting their work to hot gas welding whereas high frequency welding is being more extensively studied in England. This may be due to the difficulties which confronted British engineers in the early stages of development when the PVC available in England proved to be unweldable by the hot gas method and they were by circumstances forced to explore other ways. At present the British are experimenting on the hot gas welding of polythene.

High frequency heating was then found to be more promising for the joining of PVC. That not too much has been done in Germany in respect to high frequency heating may be due to the close restrictions imposed in that country on all short-wave equipment which of course could be employed for communications purposes as well. It is a well known fact, however, that if the welding of plastics tubes and pipes is taken up on a larger scale than at present, hot gas welding will undoubtedly be generally adopted. High frequency welding of pipes although possible is rather expensive to be practicable at this time.

The sealing of thin thermoplastic sheets and foils by high frequency is a much faster and more satisfactory process than sealing by heated platens, wedges or hot gas, especially when large quantities are involved. It can be stated that large numbers of envelopes and containers for articles to be sent to tropical countries are now manufactured in England in this way. The peace-time developments of the motor-car industry, food manufacturers, the clothing trade and many other industries will benefit by the various applications of plastics welding.

In a case where the job consists of sealing PVC tubes, a piece of equipment not unlike a resistance welding machine was designed and put into operation. It is entirely mechanized. The full cycle consists of closing the pneumatically-operated electrodes, passing the welding current through the plastic tubes, having a dwell period of predetermined time, releasing the pressure and withdrawing the electrodes. This is initiated by pressing a single push-button. Holding jigs loaded with the tubes to be sealed are passed through the machine. The complete cycle is finished in slightly less than 10 sec. This machine is capable of a mass output of from 30,000 to 40,000 1" welds per day. The operation of it requires no particular skill on the part of the operator or his two assistants.

Mr. Haim concluded with the speculative surmise that requirements of the building industry, particularly for the reconstruction of houses, will prove the hot gas welding of PVC tubes and pipes invaluable, especially as enough skilled plumbers will not be readily available. END

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PROBLEMS in *plastics*

Problems and questions may be submitted to this department for answering by the technical editors or specialists in the industry.

Has mercury an effect on phenolics?
C. N., San Froncisco, Cal.

The only effect is a slight tendency of scum to form on the surface of the mercury itself. This is due more to the contact with oir thon to the phenolic. A materiol high in lubricont should be washed in gosoline before contoct with the mercury to remove surfoce lubricont.

* * *

Is there a difference between laminated and molded phenolic?
J. F. B., South Bend, Ind.

Yes, the fundamentol difference between them is the nature of the filler used. The resin is basically the some, olthough in the molded group it hos been developed along the lines of speed of cure, o characteristic which is not so importont in the lominated industry.

* * *

Is polystyrene available in stock forms?
R. G. E., Tempe, Ariz.

No, it is now securely estoblished os o stondord molding compound and is best suited for injection molding.

* * *

What is the difference between laminated and molded phenolics?
T. R., Billings, Mont.

The fundamental difference lies in the nature of the filler used. The resin is bosically the some olthough in the molded group it hos been developed along the lines of speed of cure.

* * *

What gives the best surface and takes the best polish in phenolics?
B. G., Enid, Okla.

Wood flour stock is best suited for these purposes.

* * *

Could you tell me where I can obtain a contact-setting, air-drying resin for "no pressure" laminations?
H. T. H., Chicago, Ill.

In order to bind ony laminote, it is almost olways necessory to have ot least some omount of pressure, but the omount necessary is contingent on both the moteriol being lominoted ond the size of the finished piece. If it is o large sheet, it is impossible, to our knowledge, to hove ony success without any pressure at oll. On very small objects a form of casein glue would serve the purpose.

* * *

Where can I obtain information on the treatment for and remedy of dermatitis contracted from resins and plastics?
K. B. S., Sondy Hook, Conn.

This information moy be found in "Occupationol Diseases of the Skin," poges 354 ond 371, by Schwartz and Tulipon, published by Leo ond Febiger, Philadelphio, Po.

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WHAT'S *New* IN PLASTICS

Plastics-Surfaced Plywood

Kimberly-Clark Corp.
Neenah, Wis.

In order to improve the characteristics of plywood in cases used to carry delicate equipment, the company has developed a line of phenolic resin-impregnated papers for application to tough waterproof skin. This ma-

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"Compar" for Gear Transmission

Resistoflex Corp.
Belleville, N. J.

Application of a vinyl resin derivative to ring-gears that mesh with metal gears on revolving turret machinery, replacing rubber. (Photo above).

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Another new use for *Compar* is in a flexible solvent-proof hose for the hot-doping process used by Pan American Airways for covering fabric surfaces on Boeing B-314 flying boats. (The material is already widely in use for hose handling aviation super-fuels.) In hot-doping, the solution handled

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Each item in this section is keyed with a number which should be entered on the postcard to facilitate identifying the exact product, process or publication about which information is desired.

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WHAT'S *New* IN PLASTICS

Plastics-Surfaced Plywood

Kimberly-Clark Corp.
Neenah, Wis.

In order to improve the characteristics of plywood in cases used to carry delicate equipment, the company has developed a line of phenolic resin-impregnated papers for application to the base plywood to form a tough waterproof skin. This material—*Kimpreg* plastic surfacing—is neither plywood nor a conventional thermosetting plastic laminate, but may be likened to an alloy, combining the desirable properties of the plastics with the low cost and strength of the base plywood.

Plywood surfaced with *Kimpreg* is currently produced for use in export shipping containers with waterproof internal adhesives. As compared with conventional waterproof plywoods, the *Kimpreg* plastics-surfaced plywoods have about 1/20 the water absorption, extremely low moisture vapor permeability and a tough, abrasion-resisting surface.

The American Furnace Co., St. Louis, has designed and produced shipping cases of *Kimpreg*-surfaced plywood.

Shipping Case MK-1 for fragmentation bomb accessories was packed originally in a sheet steel-lined wooden box. The pack was not entirely satisfactory since under handling shocks the metal liner occasionally sprung, permitting water to enter and spoil the contents. American Furnace Co. designed a box with *Kimpreg* plastics-surfaced Douglas fir plywood, 3/8" thick, exterior type. Using 18-gauge sheet metal angles and riveted construction, a hoop was made to form the sides of the box. .....(117)

New Source for Plastics

Mathieson Alkali Works
New York, N. Y.

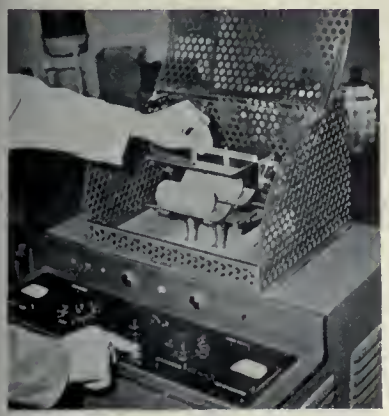
A new compound called dichlorostyrene from which heat resistant plastic or synthetic rubber can be made.

A Mathieson plastic prepared from dichlorostyrene has both excellent heat resistance and electrical insulating properties. Other plastics with either one of these properties are available, but the Mathieson plastic, it is claimed, is unique in its combination of properties, being more resistant to heat than any plastics material which combines excellent electrical characteristics with good strength, machinability and moldability. It is expected to be important in electronics and, in general, wherever electrical insulation at high temperatures is required.

The Mathieson rubber, which is made from dichlorostyrene and butadiene, is now undergoing government-sponsored road tests in the form of heavy-duty tires for trucks and buses. ..... (118)

Curved Electrodes for Preheating

Airtronics Manufacturing Co.
Los Angeles, Calif.



A special output electrode arrangement for effective preheating of domed plastics preforms. This arrangement is a standard accessory for Airtronics' high-frequency preheating equipment.

Comprising dual curved lower electrodes in combination with a standard flat upper electrode, the arrangement effects uniform heating of the preforms by placing them on edge in

the lower electrodes which are curved to insure uniform heating throughout. These electrodes also preheat conventional cylindrical preforms very effectively and markedly reduce heating irregularities due to variations in preform thickness.

The lower electrode assembly is readily removable, thereby facilitating transfer of the preheated material to the molding press. An air gap adjustment on the upper electrode assembly regulates the air gap between upper platen and preform charge. Use of an air gap can facilitate evaporation of volatiles and minimizes irregularities in heating .....(119)

"Compar" for Gear Transmission

Resistoflex Corp.
Belleville, N. J.

Application of a vinyl resin derivative to ring-gears that mesh with metal gears on revolving turret machinery, replacing rubber. (Photo above).

The new rings increase service life five times. *Compar* is molded of the same basic material as is used in Resistoflex oil and gasoline-proof hose assemblies, and can be varied to give the exact degree of flexibility, elasticity and abrasion resistance needed for a particular application.

Another new use for *Compar* is in a flexible solvent-proof hose for the hot-doping process used by Pan American Airways for covering fabric surfaces on Boeing B-314 flying boats. (The material is already widely in use for hose handling aviation super-fuels.) In hot-doping, the solution handled

To simplify for our readers the task of obtaining detailed information regarding the new products, processes and trade literature described herein, ***PLASTICS*** offers the prepaid postcard inserted here.

In rapidly-moving times such as these, keeping up with every latest development in one's field is a "must." War's insatiable demand for swifter production, and the competitive drive toward lower manufacturing costs require that all avenues leading to a solution of these problems be explored thoroughly.

Each item in this section is keyed with a number which should be entered on the postcard to facilitate identifying the exact product, process or publication about which information is desired.

is heated to 175° F. Wear-resistant qualities prevent damage from dragging the hose over the floor, being stepped on, pulled to considerable heights or run over by trucks. It also makes possible saving of as much as 34 hr per 1000 sq ft of surface treated, with a decrease of 84 lb per plane. Four or five coats of hot dope now accomplish what 11 coats formerly did, and finishing can be done regardless of weather. Blushing and mildew have been eliminated. .....(120)

Plastic 85.7% Lighter Than Cork

U. S. Rubber Co.
New York, N. Y.

Plastics foam weighing only 1/7 as much as cork, now being manufactured for important war uses. Important peacetime uses foreseen include insulation for trains, airplanes, automobiles, homes and in lifesaving equipment such as life preservers and floats and as buoyancy units on pleasure craft, providing extreme buoyancy in combination with a minimum of weight.

Although buoyant, the material is semi-rigid. Because it contains so much air space, it has good insulation and sound-deadening properties in comparison to its weight, which is less than 1½ pcf, and can be made to weigh as little as ¾ pcf.

The new product is called *Flotofoam* because of its extraordinary buoyancy .....(121)

Acrylic Tomato Slicer

Jack E. Wingate
3841 N. High St.
Columbus, O.

Purpose of the unit is to effect a 20-to-1 saving in time over the usual method of hand-slicing, also to salvage by neat-slicing the two end pieces ordinarily discarded when the hand method is used. (See photo in "Plastics At Work" section in this issue.)

Inventor plans to produce the unit in different colors and in two models—lighter one for homes, heavier for restaurants.

Note the double-acting hinge which permits forward-backward motion as well as up-and-down in slicing; also, the point on the blades which facilitates piercing the tomato and prevents slippage. .....(122)

New Aliphatic Derivatives

Connecticut Hard Rubber Co.
New Haven, Conn.

Compounds consisting of the even-numbered normal hydrocarbons from C_8 through C_{18} and the corresponding olefins, alcohols, ethers, mercaptans, thioethers, disulfides, and sulfonic acids, developed as a result of research in synthetic rubber. Most of these new chemicals are available in commercial quantities and are supplied in various grades from technical to "fine chemical".

The saturated n-alkanes are suggested for use as organic intermediates, laboratory solvents, and as standard hydrocarbons. The olefins, with the double bond at the first carbon, are interesting in organic synthesis, particularly as a starting material for dispersing agents, resins and oil additives. Certain branch chain olefins, isomeric with the n-compound of this series are available for laboratory research. The alcohols are also suggested as intermediates for chemical synthesis.

The aliphatic ethers are an interesting series which can be used as plasticizers, impregnating agents, solvents and heat transfer liquids.

The high-purity aliphatic mercaptans present possibilities as polymerization conditioners, intermediates for synthesis, corrosion inhibitors, oil additives and flotation agents.

The thioethers and the disulfides are suggested for use as plasticizers, stabilizers, oil additives and flotation agents. (123)

"Styron" Test Equipment Covers

Elmer E. Mills Corp.
Chicago, Ill.

Application of *Styron* (Dow polystyrene) for gable type covers on serological bath, used by the Army Medical Corps for use in Wassermann and Kahn tests of blood samples at constant temperature of 37° C and 56° C. The cover was designed by the Precision Scientific Co., manufacturers of laboratory equipment.

Advantage of *Styron* in this application aside from its toughness, transparency and resistance to corrosion, is low coefficient heat transfer, which makes a good thermal insulator allowing the maintenance of constant temperature inside the water bath.

The cover allows condensation of moisture to run down the side of the covers and drop off into the water bath instead of into the test tubes as occurred with old type materials used .....(124)

All-Plastics Collapsible Cup

Plastic Molded Products, Inc.
Los Angeles, Calif.

Known as the *Zip-Sip* collapsible drinking cup, this product is a modern version of the familiar folding cup of pre-war years.

It is produced of *Tenite* 1 using a 2-unit, 10-cavity mold and cast on a 12-oz lester.

The cup has a dust-repellent lid, and folds into a small compact unit which fits into any purse, pocket or lunchbox .....(125)

Reinforced Fiberglas for Helicopter Cabin

U. S. Rubber Co.
Mishawaka, Ind.

A fiberglas material (laminated and reinforced with thermosetting resin) which forms the basic cabin structure of the Sikorsky R-6 helicopter, an aircraft used for a variety of war purposes. (Photo left).

Weighing half as much as aluminum of a similar thickness, the material also offers high tensile strength, rigidity, ability to withstand strains and excessive vibration, nonconduction of electricity, resistance to gasoline, oils, acids, most alkalis, alcohol and fungus growth. After blows, it returns to normal position without permanent distortion. It retains all ordinary properties in sub-zero climates as well as in tropical areas.

The material is described as the first use of laminated plastics on a production basis in this type of construction. Another use is as a support for bullet-sealing fuel cells in all types of combat planes. .....(126)

Plastics Auto Tire

Goodyear Tire and Rubber Co.
Akron, O.

Already run 8,000 miles, the tire raises the possibility that plastics will compete with both natural and synthetic rubber in the near future.

The tire is made of *Plioflex,* new elastic plastics material developed by Goodyear. Perfection of *Plioflex* was first announced last summer at the time of the dedication of Goodyear's new laboratory in Akron. Since then a wide variety of applications of the material have been investigated of which its possible use for automobile tires is only one.

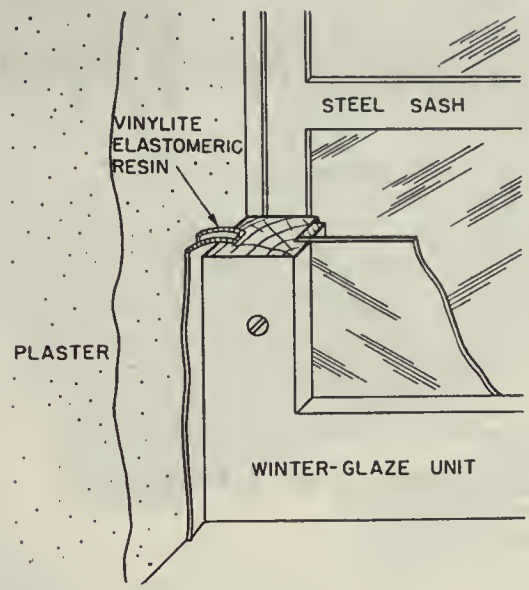
Plioflex is the first elastic plastic capable of being vulcanized during molding operations. It can be handled in hot molds exactly like natural rubber.

Tests have already demonstrated that it is superior to natural rubber in that it is not affected by the sun's rays, while natural rubber is highly sensitive to the ultra-violet radiation of the sun and for this reason the life of many rubber products is greatly shortened by exposure. This defect of natural rubber means that in the construction of automobile bodies where molded natural rubber is used for weather-stripping on the windows, it has been found necessary to provide metal coverings to protect the rubber. Thus, *Plioflex* could be used as garden hose. The Goodyear Research Laboratory has produced a flexible garden hose of *Plioflex* so light that a small child can easily pull it around a lawn. This is possible because the hose can be made without the inclusion of fabric which adds to the weight and awkwardness of the ordinary garden hose.

Other potential uses include a great variety of automobile and electrical parts now molded from rubber, all sorts of hose and tubing, shoe heels and soles, and coated fabrics.....(127)

"Vinylite" Storm Sash Seal

Bakelite Corp.
New York, N. Y.



A storm sash seal made of *Vinylite* elastomeric compound which effectively prevents any leakage of heat. Rubber seals subjected to sunlight and interior heat stick to the window frame, while felt seals absorb moisture and relay it to the jambs. The *Vinylite* does neither, and can be used even against papered returns without marring the paper. It fits snugly against irregular spaces to seal all openings and retains resilience even after lengthy use. Installation of the seal is illustrated above. .....(128)

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Literature Review

Geon Latex Bulletin

B. F. Goodrich Co.
Akron, O.

Contains general properties and compounding information on the latex, a true colloidal solution of *Geon* vinyl chloride resin in water without using any organic solvents. The nature of *Geon* latex, its stability, physical properties, compounding, including the admixture of water soluble liquids or water soluble or dispersible solids with the latex, and suggested formulations are discussed. The vinyl chloride latex development was announced by the company several months ago and expands the field in which these resins can serve. .....(129)

Casting "Tenite II" for Tools

Tennessee Eastman Corp.
Kingsport, Tenn.

Describes the casting of this thermoplastic material for industrial tools. Issued for the benefit of tool engineers, the booklet should be of particular interest to aviation companies and other industries engaged in the forming of sheet metal.

Plastic forming tools, according to the booklet, are preferred to metal ones in many cases because of their relatively low cost, time-saving, and lighter weight, showing their most pronounced advantage in tool parts that must fit mating contours, since double-compound curves can be cast as easily and quickly as flat surfaces.

The booklet points out that forming tools such as "drop-hammer punches and forces and draw rings for double-action draw presses are cast in *Tenite II* from the dies with which they are to be used." These tools are made by "casting a molten plastic into or around finished shapes or models." The booklet gives a detailed description of the procedure to be followed in casting *Tenite II*, with specific reference to the casting of a drop-hammer punch.

It is stated that *Tenite II* will form sheet metal into the corners of a die without becoming rounded as do lead and soft metal alloys; can be cast to finished size in the die without the scraping and polishing which is necessary with metal punches; has greater strength than other thermoplastics used for casting; is relatively unaffected by temperature changes; the composition may easily be made harder or softer; and the finished casting is easily machined. .....(130)

Physical Properties of Tenite II Melt Cast (Formula 236-S5)

	ASTM Test Method	TEST CONDITIONS Temp. (°F)	TEST CONDITIONS Relative Humidity (%)	PROPERTY RANGE *Specification Value	PROPERTY RANGE *Superior Value
Flow temperature (°F)	D569-43	77	50	243	263
Specific gravity		77	50	1.15	1.10
Hardness (Rockwell R scale)	D229	77	50	27	65
Elongation, 2" gage (%)	D638-42T	77	50	78	96
Izod Impact Strength (Ft-lb/In of Molded Notch)	D256-41T	-40		1.5	2.6
		77	50	5.3	9.7
Tensile strength (psi)	D638-42T	77	50	1100	2300
		160		500	1300
Flexural strength (psi)	D650-42T	77	50	1100	3100
		160		600	2200
Modulus of elasticity (psi × 10⁵)		77	50	0.38	0.82
		160		0.18	0.43
Distortion under heat (°F)	D648-41T			100	112
Deformation under load (cold flow)		122		49.7	42.0
Water absorption (24 Hr immersion)					
Total (%)	D570-42	77		1.8	1.4
Soluble matter lost (%)	D570-42	77		0.4	0.1
Accelerated aging—72 Hr—					
Weight lost (%)		180		3.3	2.2

(*) The figures in these two columns represent the high and the low value of each property to be anticipated as the average for the number of specimens required by the ASTM method of making the determination.

the plastics LIBRARY

RETAILERS' HANDBOOK ON PLASTICS,
by the SPI and National Retail Dry Goods Association, New York, N. Y.

Designed to reach the NRDGA's 6000 member store executives, this handbook will be published in complete form in the December, 1944, issue of that association's publication, *The Bulletin,* after which it will become available in bound form to the public.

It is the intention of the organization to use this volume as a permanent technical reference for retailers. Topics to be covered include the retailer's responsibility in merchandising plastics; a summary of basic processes and materials included in the plastics industry; a description of industry organization; a list of developments from 1943 to 1944; promotion ideas; sales training aids; a glossary of terms; and a description of the SPI and its functions.

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RHEOLOGY,
by G. W. Scott Blair, F.I.C., F. Inst. P.

A study of the science of plastics flow, elasticity and matter deformation with particular reference to synthetics, particularly plastics and rubber, foods, oils, gases, metallurgy, hydro- and aero-dynamics, biology and many other industrial materials. Rheological phenomena and their measurement and interpretations are thoroughly discussed.—*The Pitman Publishing Corp., New York, N. Y. 201 pages, $4.*

•

PLASTIC HORIZONS,
by B. H. Weil and Victor J. Anhorn.

If more books of this type were written, the public would have a much clearer conception of what plastics are and do than it does today. Here is an easy-to-read volume, which still presents all the basic chemical facts one must know in order to understand plastics, including the formulae of various substances and drawings of machinery and equipment used in processing.

The style of writing throughout is breezy and interest-holding —a noteworthy accomplishment when dealing with a basically technical subject. Of particular importance is the chapter on "Plastics in a World at War," showing, among other things, the role of plastics in coating the cables used to combat magnetic mines, and in providing musical instruments which can stand all climates from Arctic cold to African heat (see article "There's Music in Plastics!" in this issue).

One particularly handy chart appears in the chapter "Plastics and the Future," giving a handy comparison of various physical and chemical characteristics of 13 types of plastic materials in a form which is easy to grasp. Values of 1 through 10 are given, with general-purpose phenolic, for example, rating 10 in impact strength, as against 1 for aceto-butyrate.—*The Jaques Cattell Press, Lancaster, Pa., 169 pages, $2.50.*

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CUMULATIVE INDEX TO THE CHEMICAL FORMULARY

A comprehensive index covering all the formulae contained in the six volumes of *The Chemical Formulary.* Arranged in strict alphabetical order to facilitate quick reference, the index is also cross-referenced throughout.

The formulary contains close to 4000 pages of formulae for use in a wide variety of industries, thus making the index an essential adjunct.—*Chemical Publishing Co., Brooklyn, N. Y., $4.*

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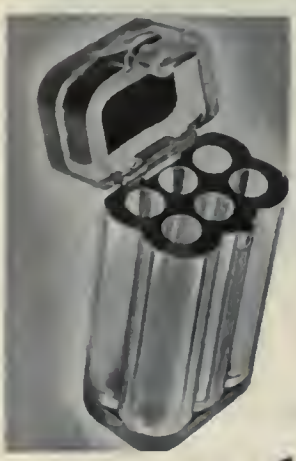
Addison

PRECISION injection molding achieved in this plastic detonator cap container:



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association activities

SPI Creates Public Relations Department

Albert Pfaltz

A full time public relations department under the direction of Albert Pfaltz has been established by SPI.

For the past 8 years a member of the senior staff of the National Electrical Manufacturers Association, Mr. Pfaltz was active in NEMA publicity, business development programs and postwar planning, and was editor of the *Adequate Wiring Reporter*, newspaper of the National Adequate Wiring Program.

The Public Relations Department will release articles for publication in the trade press and in general circulation publications, and will report on developments in the industry of specialized and general interest, slanted to acquaint particular industries and the public with plastics. "Deglamorization" will be a keynote of material released.

Radio programs will be scheduled to augment the activity, and a service will be maintained for authors who are writing articles on plastics to see that they are provided with factual information. Magazines and newspapers will be informed that SPI will assist them in seeing that correct data on the industry is provided.

$1000 Baekeland Award

Recognition of the accomplishments of American chemists under 40 years of age is the aim of a biennial award of $1000 to be offered by the North Jersey section of the American Chemical Society, with the co-operation of Bakelite Corp., New York City, beginning in May, 1945.

The award, which will include an inscribed gold medal, will be made for outstanding work in the field of pure or industrial chemistry. A jury of at least five members will make the selection. Nominations for the award will be received by the chairman of the section not later than December 1 of the year preceding the award; announcement of the recipient will be made at the regular February meeting of the section.

Adhesives, Plastics Manufacturers Merge

The Resin Adhesive Manufacturers' Association and the Plastics Material Manufacturers' Association have merged, with the former assuming the status of a division within the latter in handling technical matters relating solely to resin adhesives. All but three member corporations of the RAMA were already members of the PMMA.

PMMA, ASTM Join in MIT Research Project

A study of the fundamental engineering properties of plastics with a view to developing better testing methods has been launched by the Plastics Materials Manufacturers' Association at the Massachusetts Institute of Technology under the direction of Robert S. Williams, deputy dean of engineering. Guidance is to be furnished by the American Society for Testing Materials.

Display Fixtures from Douglas Fir Plywood

How to build your own display fixtures from this type of material is described in a 20-page bulletin recently issued by the Douglas Fir Plywood Association, Tacoma, Wash. Purpose of the pamphlet is to provide suggestions for modern retail store owners, featuring the increased use of low backs—fixtures and screens—in show windows, to give a view of the interior from the street and permit more daylight in the store.

Whitlock Outlines Molding Problems

"A large percentage of molding culls which find their way into the scrap barrel have gone there because of inadequate knockout arrangements and fixtures which are just as necessary to a successful molding job as is the mold itself." This statement highlighted a recent talk given by Carl H. Whitlock, Detroit branch manager of the Monsanto Chemical Co., before the Cleveland SPE section.

He discounted the promise of radio frequency in pre-heating of molding compounds on the grounds that its cost is excessive. Describing the increase in demand for high-impact molding materials for war uses as "tremendous," he stated that this necessitated changes in mold operation: e.g., the use of higher pressures to permit finishing of the part so as to remove flash at the parting line; and the use of steam channels and other heating facilities to eliminate cold spots in mold resulting from speeding up of molding cycles.

Mr. Whitlock pointed out that materials selected for transfer molding should have a fairly slow and gradual polymerization cycle; that standard materials cannot be used with success for jet molding, and the most molders have found it necessary to add some form of lubrication to make the material flow through the nozzle.

Mold design, he said, has progressed to the point where the molding characteristics of compounds must be carefully considered and the mold designed accordingly. This was not the case several years ago, when the only factors in molding compounds recognized by the mold designers were the type and bulk factor of the material. Molds were produced for the sole purpose of molding a part to a desired shape to within reasonable tolerances.

Reduces Lacquer Costs

A saving in solvent and reduction in number of finishing coats has been achieved by using nitrocellulose lacquers of increased solids content at spraying viscosity, according to William Koch in a talk before the division of paint, varnish and plastics chemistry at the meeting of the American Chemical Society recently in New York. This development, which reduces the cost of lacquer applications, does not sacrifice the high-quality performance of nitrocellulose lacquers. The solids content of these materials, Mr. Koch showed, can be increased by using lower-viscosity type nitrocelluloses and larger proportion of non-oxidizing alkyd resins with either a more active solvent, or by applying the lacquer by a hot-spray method.

The results obtained by using each method were found to be cumulative when two or more were used at the same time. The percentage increase in solids content ranged as high as 114% by combining the four above-mentioned methods of increasing solids content.

Nitrocellulose lacquers dry rapidly to a hard film without necessity of baking; also have good resistance to temperature change, scuffing and printing, are easy to finish.

SPI Plastics Pioneers Plan Nov. 12 Meeting

A dinner meeting for Sunday evening, November 12, is planned by the Plastics Pioneers of the Society of the Plastics Industry preceding the Society's Fall conference at the Waldorf-Astoria in New York, November 13 and 14.

Arrangements for the meeting have been made by W. L. Kelly of the General Industries Co., Chicago; John Rossiter of Michigan Molded Plastics, Inc., Dexter, Mich.; and H. S. Spencer, chairman of Plastics Pioneers.

St. Louis SPE Studies Electrical Field

"Plastic Chemistry in the Electrical Industry" was the subject of a monthly meeting held recently by the St. Louis SPE section at which a talk was given by W. C. Goggin of Dow Chemical Co. on this topic.

Officers recently chosen by the Plastics Club of St. Louis were as follows: J. Kenneth Craver, Monsanto Chemical Co., president; Harrell Creasey, Emerson Electric Manufacturing Co., vice-president; Raymond E. Lange, Solvents and Chemical Division, Fuel Oil Co. of St. Louis, secretary; and Herman Buergler, Brass and Copper Sales Co., treasurer.

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INDUSTRY HIGHLIGHTS

An 88% reduction in glue curing time required for its PBM *Mariner* ammunition boxes has been effected by Glenn L. Martin Co. wood shop employes through the development of a new device which operates on the "toaster" principle, using direct application of heat. (Photos below.)

The old method, which took 3 hr, involved assembling the boxes on jigs and baking them in a curing oven for 2-4 hr. The new device, which cuts the time to 15 min, consists of two jigs. On one is assembled the tops and bottoms of the ammunition boxes. The bottom is then placed on the second jig, where the four sides of the box have been assembled and angles glued to corners. The device is closed, clamps placed in position and pressure screws turned, forcing parts of the assembly solidly to the heat box. A 220 v electric air strip heater is completely enclosed in refractory material, encased in a steel sheath and covered with masonite to provide 120° F heat without scorching the wood. Low temperature is thermostatically controlled throughout the curing process to maintain uniform gluing. The assembly can be observed through the curing cycle.

•

U. S. Plywood Corp. announces the sponsorship of an architectural competition for the ideal post-war average American home in conjunction with the magazine "Arts and Architecture." Prizes total $2500, including a first prize of $1250. Closing date for entries is December 20. Types of materials used in construction are not limited.

Tops and bottoms of the plywood ammunition boxes at G. L. Martin Co. are cured in a device resembling a sandwich grille

The second step is to place the entire ammunition box in a second "toaster", this one of the automatic pop-up type

Amperex Electronic Corp., Brooklyn, formerly Amperex Electronic Products, has become affiliated with North American Philips Co., Inc. New directors and officers of the former are: A. Senauke, president; Nicholas Anton, vice-president, manufacturing; and Samuel Norris, vice-president, sales.

•

Short cuts in developing a new resin ester from test tube to full-scale plant operation, which cut the time involved from the usual 1-2 years to as little as 1 month, have been achieved by Hercules Powder Co., according to announcement at the ACS' recent annual meeting in New York City.

•

Thermoplastic laminates, based on cellulose derivatives with varied fillers, have an extensive post-war future in semi-structural aircraft parts, housings, electrical insulation, boats, luggage and furniture, according to C. W. Eurenius of the same company in a talk at the meeting.

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All stock and other securities of the Universal Oil Products Co., Chicago, a leading research and development organization, would pass to the American Chemical Society under the terms of a gift offered by the company, it was announced by Dr. Thomas Midgley, Jr., ACS president, at the group's recent annual dinner at the Waldorf-Astoria.

Value of the Universal Oil Products Co. is estimated at from $10,000,000 to $15,000,000. The firm's income, which would be used for research under the direction of the society, averages $1,000,000 a year.

The company is owned by Phillips Petroleum Corp., Shell Oil Co., and the Standard Oil Companies of California, Indiana and New Jersey, and the Texas Co.

Results of the research will be published and made available to the public without payment. The donors will have no rights to such results greater than those of the public at large.

Universal Oil Products organization is presently devoting its entire efforts to the aviation gasoline program, involving six basic processes developed by Universal of which there are approximately seventy-five installations in successful operation in the different refineries scattered throughout the nation.

•

In order to ease the handling of allocated materials during the reconversion period, the WPB has amended Order M-300, the general chemicals order, making it possible to continue control over that part of chemical distribution that is essential for the war effort without governmental supervision over uses of chemicals in the production of specific civilian items.

Consumers are required to submit to the supplier a certified statement of end use.

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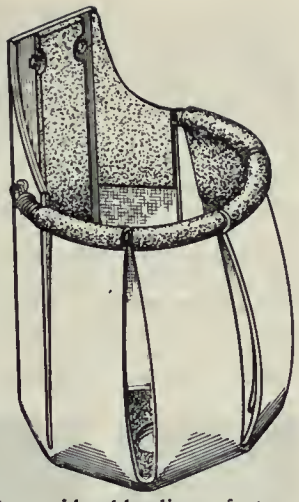
Purchase of a 12-acre plot for a postwar manufacturing plant in Anaheim, Calif., for the manufacture of plastics parts for airplanes is announced by General Electric Co., according to an announcement by W. H. Milton, Jr., manager of the Plastics Divisions.

•

The Mid-States Gummed Paper Co., Chicago, one of the larger concerns in the field of gummed paper and cloth tape and gummed label manufacture, has been acquired by Minnesota Mining and Manufacturing Co., St. Paul, originator of *Scotch* tape. The purchase price was in the neighborhood of $1,000,000, and the acquisition brings to Minnesota Mining 171,250 additional sq ft of plant, office and warehouse space in the 3-story property occupied by Mid-States at 2515 South Damen Ave., Chicago, with 270 ft of track frontage on the Burlington Railroad's right-of-way.



Low-pressure plastics laminates are now used by Consolidated Vultee Aircraft Corp. for a new-type portable oxygen bottle container for aircraft. The container is a shell-like structure made of cotton fabric impregnated with a suitable phenolic resin and molded to conform to the contour of the bottle. Construction is of the "orange peel" type.

Before the portable container was developed, it was necessary for each aircraft crew member to carry a portable oxygen supply on his person throughout the course of a high-altitude flight. The bottle was usually attached to the crewman's clothing by means of a spring clip, which caused considerable discomfort.

Convair's new container makes it possible for the individual crewman to hang his portable oxygen bottle on a suitable bracket near his flight station inside the airplane as long as he can remain in one position and breathe oxygen from the ship's main supply. To protect the finish of the oxygen bottle, and to prevent undesirable vibrations, strips of felt are glued to the inside contact surfaces of the container.

•

The Neville Co. discloses the opening of an experimental pilot plant at Pittsburgh for producing "fool-proof" samples of resin and plasticizing oils under commercial conditions and in sufficient quantities for thorough testing in the plants of prospective users.

Developed by Lyle M. Geiger, director of research at Neville, the plant has a capacity of 1500 lb per charge. A versatile arrangement of piping permits taking material to and from each piece of equipment, and the equipment is set-up so that all resin and plasticizing oil production processes of the main plant can be quickly duplicated.

Resins and plasticizing oils, such as PHO, a plasticizing oil, and *Nevillac* phenol indene-coumarone, being developed independently by Neville for the trade, are also being tested at the pilot plant, which permits the working out of the most efficient production process before bulk production of a new development begins. This eliminates wasteful experimentation, re-runs and consequent loss while using large equipment.

One important piece of equipment is a high vacuum still where less than 1/760th of atmospheric pressure is maintained. Among other special equipment are reactor and receiver, still feeding tank and still receivers, dryer and receiving tank, filter press, centrifugal, experimental still for production of softeners for synthetic rubber, and storage tanks.

•

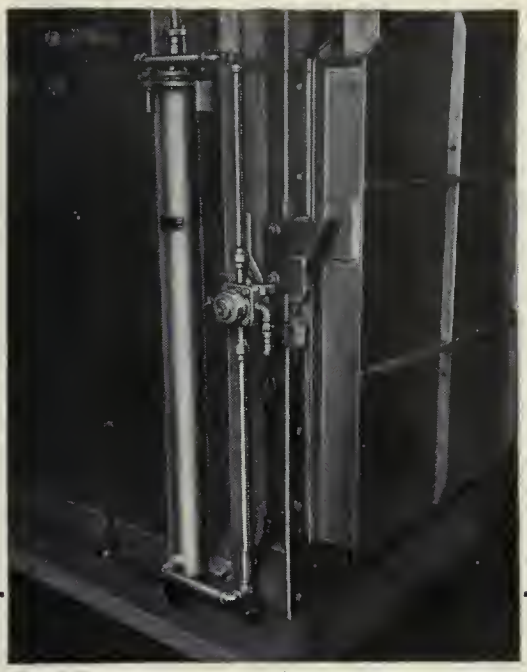
Three new plywood distributing warehouses have been opened recently by U. S.-Mengel Plywoods, Inc., jointly owned by The Mengel Co. and U. S. Plywood Corp. These are located at New Orleans, Jacksonville and Atlanta. A fourth was opened last January at Louisville.

•

The Chicago office of the Catalin Corp., reopened October 1, is located in Suite 1119, 221 N. La Salle Street. I. F. Ferguson, Mid-west district manager, is handling all sales in the area of *Catalin*, cast phenolic resin, *Loalin*, polystyrene injection molding compound, *Catabond* and *Catavar*, liquid phenolic resins, and the new high impact lignin compression molding compound, *Catapak*.

•

Employes of the Worcester Moulded Plastics Co., Worcester, Mass., were recently awarded their third Army-Navy production award with two stars for high achievement in the production of war material. The firm, according to announcement, is the first custom injection plastics molder in the country to win such recognition for the third time.



Used by Curtiss-Wright Corporation at Buffalo and St. Louis plants

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THE INSIDE STORY

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PEOPLE

Recent announcements made by the E. I. du Pont de Nemours and Co. include the appointment of **John F. Daley** as general manager of the Pigments Department, succeeding the late **Carl H. Rupprecht. Dr. Robert Emmett Burk** has joined the department as special assistant to **John L. Brill**, the department's chemical director. Dr. Burk is chairman of the Committee on Catalysis of the National Research Council and vice chairman of the petroleum section of the American Chemical Society.

Harry Krehbiel

Harriet E. Raymond

S. W. Antoville

Ted Friberg, well known in the field for many years, has joined the Industrial Molded Products Co., Chicago, as plant manager. He was formerly superintendent of the Department of Plastics at the National Lock Co., Rockford, Ill.

•

Harry Krehbiel was elected president and chief executive officer to succeed the late **William Thiele.** Mr. Krehbiel has been with the corporation for the past 13 years, having served as a vice-president and director since 1941.

•

Harriet E. Raymond has become assistant advertising manager of Celanese Corporation of America in charge of the advertising of plastics and chemicals. She was formerly advertising manager of the company's Plastics Division.

•

S. W. Antoville, formerly vice-president, has just been appointed director of sales of United States Plywood Corporation, New York City.

H. E. Back, Jr.

H. C. Kenyon

Alan Mann

Pennsylvania Coal Products Co., Petrolia, Penn., manufacturers of *Penacolite* resins and adhesives, announces the appointment of **H. E. Back, Jr.**, to the position of director of technical service, Resin and Adhesives Division.

•

Minnesota Mining and Manufacturing Co., St. Paul, announces the advancement of **H. C. Kenyon** from division sales manager to general sales manager of its subsidiary, the Inland Rubber Corp., Chicago.

•

The Board of Directors of the Catalin Corporation of America at their regular monthly meeting elected **Alan Mann** chairman of the Board of Directors. Mr. Mann has been associated with Catalin for about 11 years as patent counsel and as a vice-president and director.

Dow Chemical Co.'s Plastics Division announces the following changes in and additions to its staff:

At Midland, **C. F. Cummins**, formerly of the Chicago office, will have charge of plastic engineering activities in molding powders; **R. J. Minbiole**, formerly of the New York office will handle packaging materials. **P. W. Simmons** was also transferred from the New York office to handle protective coating materials. **F. J. Gunn** of the Midland staff assumes the handling of plastic raw materials.

In New York **F. L. Brown**, formerly of Cleveland, will have charge of all plastics engineering activities for the Eastern territory. **Gage Olcott**, recently with Bolta Co., will join the New York staff, assuming plastic engineering duties. At Cleveland, **E. R. Haines**, formerly of the company's St. Louis office, will replace Brown. At Chicago, **J. E. Russell**, formerly of the Midland office, will share with **C. R. Webster** the duties of the plastics engineering division there.

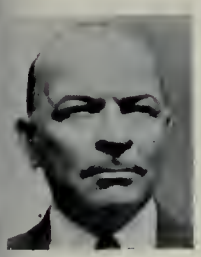
In the St. Louis office, **E. E. Chamberlin**, formerly a supervisor of plastics fabrication with Commercial Plastics' Midland branch, will replace **E. R. Haines.**

•

Maurice C. Bachner, former president and chairman of the board of Chicago Molded Products Corp., has announced his retirement.

•

J. V. Tracy, formerly sales manager of Ashcroft Gauge division of Manning, Maxwell & Moore, Bridgeport, Conn., and previously advertising manager of Consolidated Ashcroft Hancock Co., has joined the firm of Design Today, Inc., New York.



R. R. Vineyard

Dr. P. W. Ivey

W. W. Jackson

Robert R. Cole, vice-president of Monsanto Chemical Co. and general manager of the Phosphate Division, replaces the late **John C. Brooks**, vice-president and general manager of the Plastics Division, as a member of the Board of Directors.

•

Richard R. Vineyard has been named director of Winner Manufacturing Co.'s research laboratory at Trenton, N. J. During the past 3 years he has acted as chief of design for Virginia Lincoln Corp., aircraft division, and production manager of Andover Kent Aviation Corp. His post with Winner will involve developing new techniques for low pressure laminating, and production of contact-type molded products requiring no heat or pressure.

•

Dr. Paul W. Ivey is now a member of the faculty at the Plastics Industries Technical Institute. The former professor of merchandising at the University of Southern California will lecture and give instruction in the marketing and merchandising of plastics products.

•

A. L. Kindsvater has been promoted to the position of purchasing agent for the Plastics (formerly Thermo Plastics Division) of the Standard Products Co.

•

As part of an expansion program undertaken by Celanese Celluloid Corp. in its Plastics Division, **W. Ward Jackson** has been named director of the Product Application Department, New York. Mr. Jackson recently returned from Washington, D. C., where he served for almost 2 years as consultant to the WPB Chemicals Bureau.

Official U. S. Signal Corps Photograph

For successful operations EXPERIENCE counts most

JUST as combat experience helps each new victory mean more, cost less . . . it's production experience at home that's helping produce more and better fighting equipment for battle zones.

And it's this brand of experience, coupled with years of valued prewar practice in plastics that Industrial Molded Products Company offers you.

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Exterior of Infra-Red Conveyor Belt Tunnel for removing moisture from plastic material prior to molding.

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NALCO

ENGINEERING
News Letter

By LEWIS WINNER
Market Research Engineer

Applications . . . Methods . . . Materials

The rubber shortage not only has prompted the adoption of several types of thermoplastics in some industries, but has opened a new and effective source of supply that is not composed of mere substitutes. This is particularly true in the cable industry, where Polyvinyl chloride is rapidly replacing the use of pure rubber. It is estimated that close to 25% of the cables now being fabricated are insulated or sheathed with thermoplastic materials.

In polyvinyl chloride, cable specialists appear to have found a material that offers the greatest number of useful properties. There are other thermoplastics applicable, but their effectiveness lies only in specific fields. For instance, the softening point of some thermoplastics such as polythene, have a sharp softening point of about 105° C whereas polyvinyl chlorides pass through a consistently varying change of state as the temperature is adjusted. The softening point, therefore, can only be found by arbitrary standards.

Oddly enough, the problem of elasticity is not a major one in cable applications. That is, even though soft polyvinyl chloride compounds have slow elastic recovery, the elasticity is sufficient for most cable applications. Incidentally, this elasticity is a variable factor and depends upon the type and content of plasticizer.

In polyvinyl chloride we have a straight polymer built up solely of repeating units of vinyl chloride which is derived from acetylene. It is possible to prepare a copolymer such as vinylite, VYNW, which is 95% vinyl chloride and 5% vinyl acetate, that will have properties similar to polyvinyl chloride. Such material has been used for cables, also.

In a talk before the Institution of Electrical Engineers in London, J. N. Dean, T. R. Scott and Dr. H. Barron pointed out that there were seven other thermoplastics applicable to cable fabrication that have not as yet been fully adopted because of certain problems. They cited ethyl cellulose as one which has not been used because the plasticizers employed have not been completely satisfactory for many cable purposes. They also stated that it is not resistant to solvents and is inflammable. The material polyisobutylene, in itself, has never been successfully used as a cable insulation, they said. However, it has proved to be a most useful compounding agent, and as a compounding agent it has been used with polythene, polystyrene, rubber, cyclized rubber, etc. Unfortunately, however, this material is depolymerized by sunlight. Another of its defects is pronounced cold flow.

In its favor is the temperature range of its elastic properties from −70° to +180° C, believed to be the widest range known. Polystyrene, according to these experts, is too brittle at ordinary temperatures and requires the development of a suitable plasticizer to adapt it to cable insulation work. Because this material becomes quite rubbery at about 80° C, it is used as a component in Buna-S, copolymer of butadiene and styrene. Nylon was also mentioned by these experts as a cable industry material, used as an enamel for magnet wires or as an extremely strong filament for braiding. Thus its usefulness is solely as a protective material. In this same classification we have polyvinylidene chloride, which like nylon requires a high extrusion temperature. According to these specialists, it can be drawn down and thus be given additional tensile strength. This material cannot be easily plasticized. Another thermoplastic mentioned by the English scientists was cellulose butyrate acetate. They pointed out that this material is used as a tape insulation, particularly for automobile cables. The last material they mentioned, and probably the one that comes closest to duplicating polyvinyl chloride's effectiveness, is polythene, which is in some ways a complementary material; that is, a combination of polythene insulation with polyvinyl

sheathing, which has possibilities of being an ideal thermoplastic cable combination for most purposes. With such a combination of materials, it should be possible to secure high insulation resistance, low permittivity and low dielectric loss.

Dr. Barron and Messrs. Dean and Scott found that polyvinyl chloride can be applied to the insulation of cables in at least three ways: Taping, longitudinal-strip application and extrusion. The longitudinal-strip application is used in England when applying natural and synthetic rubber compounds. Since the process depends on self adhesion of materials, a property not possessed by polyvinyl chloride, this thermoplastic has not been used too readily here. The extrusion method has been the most acceptable one for applying insulation and probably the sole method of sheathing cables. Therefore, since polyvinyl chloride is one of the easiest thermoplastic materials to extrude, and very fine results can be obtained in respect to concentricity and thin walls, it is the most acceptable for this purpose. Tubings have also been made of polyvinyl chloride quite successfully. An interesting point is that in extruding polyvinyl chloride tubes it is usually desirable to provide a small air pressure to the center of the tube to prevent it from collapsing, the tube being carried away from the extrusion machine by means of a light conveyor system. In this way it is not necessary to pull the material from the die by the customary haul-off gear. While this is satisfactory for the center wire of a cable, it is impracticable for a tube requiring uniform wall thickness and diameter.

Fillers were also discussed by these experts, who pointed out that the addition of a filler to a polyvinyl chloride compound can very substantially reduce the abrasion resistance. Organic fillers, such as silica, mica, clay, carbon black, etc., increase the hardness in approximately a linear relationship in respect of the quantity added. On the other hand, resins, waxes, and factices reduce hardness. The use of carbon black and clay in small amounts can increase the electrical resistivity. Clay, according to these scientists, has raised the resistivity by 10 times at 70° C.

A typical polyvinyl chloride composition usually consists of the polymer, plasticizer, stabilizer, lubricant, pigment, filler and extender. The plasticizer is quite an important item in the polyvinyl chloride compound used for cables, said these experts. Those found most useful include tricresyl phosphate, dibutylphthalate and certain other phthalates. Citing the importance of the plasticizer, these experts said that an increase in plasticizer will cause a decrease in tensile strength and an increase in elongation. And as the amount of plasticizer is increased the hardness of the composition also decreases. The three important features relating to plasticizers are volatility, leaching, and insulation properties.

The two commercial types of polyvinyl chloride compounds available in England are *Welvic* and *Chlorovene*. In this country there are three: *Koroseal, Vinylite* and *Flamenol*. In Germany it is known as *Mipolam*.

Patents

Plastic Composition for Wall Board Joints. (2,353,822) Harry F. Gardner, Snyder, N. Y.; assignee Certain-Teed Products Corp., New York. Casein, clay and lime, each substantially in the range between 7% and 15%, are the basic plastic ingredients in this composition. The plastic consistency produced is capable of being worked under a trowel or broad knife. Requires 62-68 parts of water per 100 parts of the casein, clay and lime composition. An alkaline salt, no greater than one-third of the amount of the three basic ingredients, is also used in the composition.

Rotary Molding Press. (2,354,029) Arthur William Kingston, Denham, England. This rotary molding press for thermoplastic materials, has many molding units, each unit consisting of a resiliently mounted jacketed mold and a jacketed die capable of limited movement under spring control. Means are also provided for varying the cyclic points of admission and cutoff. A cam track for lifting the dies and supporting them out of contact with the molds, while the rotary members are rotated, is also a feature of this press. These cam tracks are adjustable.

Alkyd Resin as Plasticizer. (2,357,221) Carl Opp, Cincinnati, O.; assignee, Interchemical Corp., New York. The resinous reaction products of 37.5% sebacic acid, 28.6% sucinnic anhydride, 19.3% ethylene glycol, 14.6% glycerol. END

Rich, silver surface of plastic soap dispenser reflects dignity of fine home appointments . . . Plated for Cameo Corporation.

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able to help you plan the production of your plated plastic products.

Future of Plated Plastics

(Continued from page 34)

One metal plating application which would seem to have wide possibilities for future use is its use on a laminated phenolic safety helmet. By metal plating this helmet molded by Paramount Rubber Co., Detroit, with a 0.001 copper plate, temperatures were reduced on the inside of the helmet by as much as 50° below unplated plastics helmets. Temperature was reduced materially below that of aluminum safety helmets also, and protection was provided against impact and heat with electrical resistance, which aluminum does not. Test results on plated plastics helmets and comparisons with other type helmets are shown in Table 2.

These tests indicate that after the war sportsmen who like their fishing in the tropical sun would do well to get a plated plastics helmet. Such helmets would not only protect from flying leaders which might be mis-cast and any unexpected headers caused by heavy seas, but also from the sun. Workers in shipyards and on other out-of-door jobs where head and sun protection are dual factors of importance may soon be wearing plated plastics helmets.

Plating of plastics also brings out the detail in the molded piece to a much greater extent than in its unplated stage. The most minute detail in the molded piece is not only faithfully reproduced but actually highlighted by the gleaming metal. This is illustrated by the religious chaplet molded by Chicago Molded Products Co., samples of which had been gold-plated by Monroe Auto Equipment Co. This means that with mass production methods, articles of intricate detail can be produced at a very reasonable price.

From the standpoint of the Monroe company it would appear that the biggest future in plated plastics would be automotive hardware, a natural field for chromium-plated plastics. Here there would be no chance for reaction between the base metal and the chromium outer plate. There would be no opportunity for moisture to seep through pores in the plate and attack the base metal, causing subsequent rusting and flaking off of the chrome plate. Nor would there be any opportunity for galvanic action between metals. Plated plastics hardware which has undergone severe tests shows excellent durability. In cost it will be competitive with metal hardwares. Trim strip, dash knobs and other automotive accessories now made from plated metal and plain plastics may well be converted to metal-plated plastics.

Attractive decoration made of cellulose acetate and urea formaldehyde, covered by chrome plating

At this point considerable argument may be raised by plastics molders. For a long while they have been competing for the automotive market with metal-plated articles. The colorful qualities of plastics, their undimming beauty and the fact that they require little or no taking care of by car owners have resulted in their increasingly widespread use for automobile decoration by manufacturers. But for some time after the war, according to the automobile industry, people are going to be metal hungry, particularly for bright metal. They want

TABLE 1.—Comparison Between Plain Plastic and Plated Plastic Test Specimens

(Tests Conducted by Independent Laboratory)

Material	Water Absorbed in 24 Hr Immersion (%)		Tensile Strength (psi)		Impact Strength (Notched Izod Ft-lb per in of notch)	
	Plated	Unplated	Plated	Unplated	Plated	Unplated
Phenol formaldehyde compound	0.11	0.48			0.42	0.36
	0.08	0.45	8,550	8,075	0.44	0.31
Avg.	0.095	0.46			0.43	0.335
Phenol formaldehyde compound	0.07	0.41			0.42	0.29
	0.07	0.35	9,350	6,300	0.44	0.35
Avg.	0.07	0.38			0.43	0.32
Urea formaldehyde molding compound	0.06				0.35	0.29
	0.06	0.45	10,450	8,050	0.35	0.30
Avg.	0.06				0.35	0.295
Polystyrene	0.02	0.03	3,900	3,425	0.35	0.165
	0.02	0.09	3,550	2,650	0.38	0.32
Avg.	0.02	0.06	4,225	3,038	0.365	0.24
Methyl methacrylate	0.01	0.25			0.39	0.33
	0.01	0.24	11,575	10,700	0.34	0.38
Avg.	0.01	0.24			0.365	0.355
Cellulose acetate	0.06	2.53	4,700	4,425	2.68	2.26
	0.08	1.78	4,950	4,000	2.73	2.32
Avg.	0.07	2.15	4,825	4,213	2.705	2.29
Phenol formaldehyde	0.10	0.61			0.45	0.32
	0.15	0.63	8,450	5,675	0.51	0.34
Avg.	0.12	0.62			0.48	0.33

TABLE 2.—Comparative Tests on Heat Protection Afforded by Different Types of Safety Helmets

(Low Pressure Molded Phenolic Laminated Helmets)

Position	Unplated	Plated with 0.001" Copper	Painted with Aluminum Base Paint
1	146°	133°	181°
2	195°	123°	197°
3	174°	87°	181°
4	155°	87°	154°
	*R. T. 67°	R. T. 73°	R. T. 58°

Comparable Type Safety Helmet Made From Aluminum

Position No. 1	128°
Position No. 2	119°
Position No. 3	103°
Position No. 4	101°

*R. T. = Room Temperature

to see and feel metal. Despite all the educational efforts by the plastics industry a great section of the public looks on them as substitutes, particularly in hardware. But with metal-plated plastics the plastics industry need not lose its large volume in automobile decoration which it has built up at such a cost over so long a period. If the automobile manufacturers want metal hardware, they can get them at no tool or mold cost and with no delay for the making of new dies for diecastings or stampings, using plastics hardware molds from their last peacetime models, with a chrome-plated finish over these plastics pieces. END

Casting Plastics for Master Molds

(*Continued from page* 61)

sections, hollow places or so called "blow" holes were present in the cured plastics. This condition has been remedied by allowing the mix to stand for 24 hr before cure to allow for the trapped air bubbles to reach the surface and also to aid in dissipation of the heat of reaction. Cure is then effected beginning at a lower temperature and gradually, at intervals, brought up to standard. This method prevents boiling over which is common when curing large volumes.

All subsequent tooling built from this master has been found to be closely matched and reworks due to dimensional change have been eliminated. The smooth plastics has been found a most desirable surface from which to take a plaster splash, and drop hammer dies, check fixtures, weld jigs, and saw fixtures have been most successfully coordinated. This method of fabrication has saved many man hours and provided a relatively quick way of producing a dependable master model.

A comparative test shows the overall cost of a plastics master to be approximately one-tenth the cost of masters fabricated of mahogany. The extreme durability of this plastics master has never been attained with plaster. Tolerances can be held and maintained over a longer period of time and coordinated tooling can be built which will produce matched parts. It has been found that, although this is a specialized field and should be handled under close experienced supervision at all times, plastics have once again been brought from the realm of curiosity and development to a real necessity. Master models and dummy parts of all parts of the airplane such as enclosure masters, wing tip masters, leading edge masters, cowling masters, shroud masters, can be fabricated in less time and with greater dimensional stability by the use of cast plastics. END.

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Plastic Lenses

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U. S. pilots are today being guided into bases with portable approach lights equipped with AGA plastic lenses having light transmission comparable to the finest optical glass. Some lenses are of colorless crystal. There are brilliant single color lenses. In others, colors have been ingeniously combined by integrated precision molding to produce striking multi-colored lenses.

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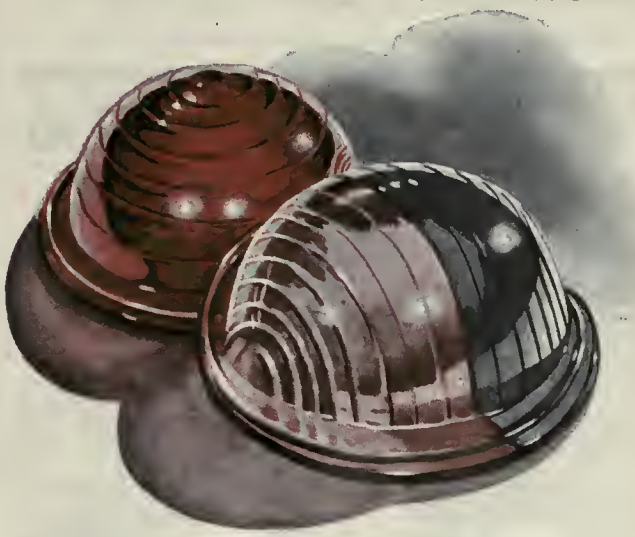

Possessing greater durability, weighing less than glass lenses and having unusual resistance to weathering, AGA plastic lenses are destined for wider postwar usage in marine, aircraft and signal lighting. They suggest smaller lighting units with greater distance visibility and marked economy in assembly and maintenance.

Our modern facilities and broad experience in the field of transparent plastic materials are available for the design, engineering and manufacture of lenses to your specifications. We invite your inquiry.

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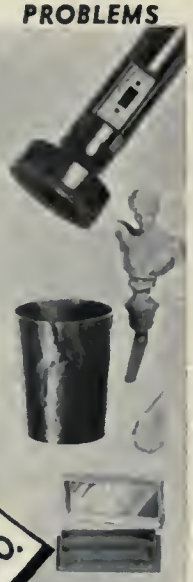

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(*Continued from page 76*)

than the brass reed, and as a result it is possible to achieve greater resiliency with the heavier reeds which are the more desirable for this application.

The low tone brass reeds vary in thickness from .010" on the heel end to .003" at toe end, while the high tone reeds vary from .008 to .002". The plastics reed varies from .021 to .018" on the low tone, to .019 to .015" on the high tone reeds. The heavier thickness in the plastics reed results in a richer and more powerful tone and still the resiliency is such that the reeds can not be choked or stopped from vibrating by normal playing air pressures. Tests have shown that the plastics reed has longer life than the conventional brass reed, being capable of withstanding the repeated flexing incidents of vibration for long periods without cracking or change in tonal qualities. The plastics harmonica is said to produce a richer and more mellow tone than the brass instrument.

Reed Mold Design

The 4-cavity mold, which was engineered by the author, is an intricate affair developed to produce a free vibrating part. The reed plate thickness is .054" and the reed plate slots and the edges of the reeds are smooth. There are no molding flash, burrs or fins. Side clearance of the reed in relation to the reed plate slots is only .002". The integrally molded reed and reed plates are injection molded in one operation and in tune. By contrast, the old method on brass plates and reeds for a like amount of plates and reeds would require 204 operations and parts; the reeds are first punch-pressed in blank from flat stock, then ground to size, then riveted to the reed plate and then individually hand tuned. Riveting the delicate reed to the reed plate alone throws the instrument out of tune. Thus, the use of an injection molded plastics has eliminated 200 operations and parts on four reed plates.

The author also has developed a chromatic harmonica which consists of 14 parts, as contrasted to the 159 parts in most popular imported chromatic harmonicas. The reeds are placed in longitudinal alignment with each other instead of side-by-side. Separate sound chambers for the "blow" and "draw" reeds produce sounds of high intensity, large volume and exceptional tonal quality. Another harmonica recently developed features communication of the reeds with the sound cells controlled by manually-operated valves or key stops. All the wind cells are connected to a common wind tube, and there is a simple mouthpiece. This instrument was developed to meet musical teachers' demands for finger manipulation of an instrument.

Other Plastics Applications

This application of polystyrene to harmonica construction is only one of numerous invasions recently made by plastics into the general field of musical instruments. Well-known already is the use of cellulose acetate butyrate in the manufacture of fifes and bugles for the armed forces. Here again, marked improvement in tonal quality has been acknowledged. The fife is a one-piece unit made of tubing produced by Extruded Plastics, Inc., while the bugle is molded by Elmer E. Mills Corp.

Versatile *Tenite* has been employed in whistles, injection-molded by Plastic Engineering, and Rudolph Wurlitzer has developed a plastics-cased accordion. As in many other fields in which plastics have replaced other materials, manufacturers contend that the plastics are certain to continue their popularity after the war. END

Battery Drain Jar

(*Continued from page* 54)

type plane being equipped. Instead of the particular arrangement of right-angled tube and straight tube shown in the illustration, the tube arrangement can be reversed, or two straight tubes used.

An interesting example of close tolerance in injection molding is the polystyrene "comb" illustrated in this article. These "combs" are used for coil forms, wires fitting into the grooves. Not the least of the features of this piece of molding is its appearance. Equipment parts or complete products molded of this material are always good looking. Polystyrene's real value to industry, however, lies in the fact that it can be molded to close tolerance with a high degree of accuracy. In the piece illustrated there are 12 grooves to the in., not cut but molded, and each held to tolerance of 0.0015". In other words, polystyrene parts can be molded to the exact degree of fineness that the die cutter can put into mold and die. Coupled with this and also important to industrial users of plastics is the fact that polystyrene can be machined accurately and to close tolerances.

These two widely different examples of injection molding offer some slight idea of the potential possibilities in the industrial use and fabrication of plastic materials. END

Fillers

(*Continued from page* 39)

In molding work using the thermosetting resins of the phenolic or urea variety, a great number of desirable qualities not inherent of the resin itself may be obtained by the judicious addition of various filler material. With the thermoplastic resins, where the plasticizer content is generally more important than other qualities, the addition of filler material is not so universally practised. There are instances, however, when certain inorganic fillers are employed to reduce the volume cost of the plastics, or to counteract the action of the plasticizer and keep cold flow at a minimum.

Demands for improvements in plastics materials originate from two distinct sources. The custom molder, primarily interested in the molding and flow characteristics of a composition that will allow him to turn out uniform products at a nominal cost, and the engineer who requires a material that will meet certain thermal, physical, chemical or electrical specifications. The plastics filler thus enters into the problems of both design and fabrication. The manufacturer will select a plastic to meet his own requirements for moldability and flow, then, by the addition of the proper filler material, make it meet the requirements of design. The numerous resins available, coupled with the fact that each can be provided with specific properties by the addition of the right filler material, explains why plastics offer so many possibilities in industrial design.

All this indicates the desirability of close cooperation between the engineer who originates the plastics specifications and the manufacturer who will be charged with fabricating the part. With all problems of both parties clearly defined, it will often be found that certain concession may have to be made.

To illustrate, design specifications may call for minimum dielectric losses. Additions of a powdered mica filler to assure this quality may reduce the strength of the plastic to a dangerous degree. It will then be necessary to incorporate a second filler of a fibrous nature to increase the strength. At the same time addition of the fibrous

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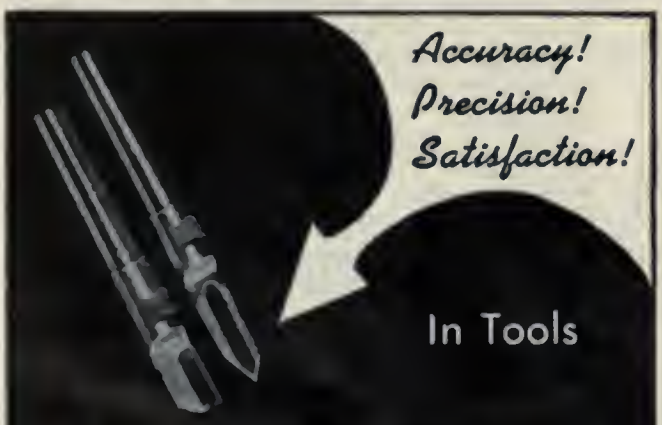

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filler may adversely affect the dielectric properties. Only by cooperation of all parties concerned can the ultimate in plastics design be achieved.

Filler materials can be ranged according to particle size, porosity, purity, surface characteristics, ease of preparation, and what effects they have on the ingredients of the plastic composition. Fillers commonly used with the moldable thermosetting plastics may be divided into two distinct types: carbonaceous or organic, and mineral or inorganic. When a filler acts to increase the strength of a plastics composition, it is generally referred to as the reinforcing type. Other fillers may have no effect on the strength of the basic composition, yet at the same time will impart specific values such as moldability, chemical resistance and electrical resistance. Such fillers are termed inert.

The accompanying table lists a variety of commonly used fillers grouped according to origin. Roughly, the organic fillers of a fibrous nature impart strength and impact resistance to a composition, while inorganic types usually develop other properties.

It is generally difficult to recognize the type of filler used by visual inspection of the finished product. Some powdered fillers do not reveal their presence and may not even tint the plastic. Fibrous fillers are generally visible, but it would require chemical analysis to ascertain their true identity. In such extreme cases as an abrasive wheel bonded by a small quantity of resinous material, the filler is so outstanding as to be instantly recognizable.

One of the first fillers ever used in molding compositions ranks among the most important in use today. This is wood flour. A most important advantage of this filler from the standpoint of the custom molder is the manner in which it contributes to lower production costs. Wood flour itself has a very low specific gravity, and when incorporated in a plastics composition will make possible the production of more parts out of each pound of basic molding material. When compared with the high specific gravity of the inorganic fillers, the light weight of the cellulosic fillers such as wood flour provide distinct advantage on a volume basis, since most plastic molding compositions are sold by weight.

Originally, waste products such as sawdust and shavings were used in the preparation of the wood flour filler material. But when the demand for greater uniformity in quality and strength of plastics began to make itself felt, producers began to exercise greater care in their choice of filler materials.

Today all wood used in the preparation of wood flour must pass critical requirements and inspection. No specific type of wood is considered best. Bark and knots are eliminated. Careful attention is given to color, residual moisture, gum content and the ease of attaining specific filler particle size during manufacture.

Great care is taken in the grinding and pulverizing processes employed during the preparation of wood flour. Research has proved that particle size and shape have a distinct bearing on the strength and other physical properties of filled molding plastics. Though the particle size of wood flour varies greatly, it will average somewhere in the neighborhood of 100 mesh.

During grinding care is exercised to assure a random distribution of the cellulosic wood fibres rather than closely-knit parallel groups of fibres. Random distribution helps assure complete impregnation with the resin and uniformity throughout the mass. Another factor that affects resin impregnation is excessive gum or lignin content. Both must be kept at a minimum for best results. When the finished plastics product must have certain electrical properties, the moisture content of wood flour filler must be carefully controlled.

The optimum filler particle size mentioned above is important not only because particle size affects the moldability, strength and performance characteristics of a plastic, but also because the size bears strongly on the finished appearance of the molded article. The appearance may vary from actual visibility of the particles, to a mottled effect or invisibility, depending upon size and color.

Considered as a general-purpose filler, wood flour enhances many favorable characteristics in the molding plastics. Impact resistance, strength, moldability, good finished appearance and excellent electrical properties are among the more important. Wood flour-filled phenolics will take a high surface polish which, in conjunction with their electrical properties, makes them ideally suited for such applications as radio panels. Wood-filled phenolics have been used for years in the manufacture of automobile distributor housings.

Wood flour as a filler, however, has certain definite drawbacks. Though it imparts fair impact resistance, certain other cellulosic fibres are much better for this purpose. Due also to the fact that the wood particles undergo no chemical transformation during grinding and impregnation, they cannot be used for applications subjected to temperatures in excess of 275° F. Shrinkage during service is another factor that eliminates wood flour where close tolerances must be maintained.

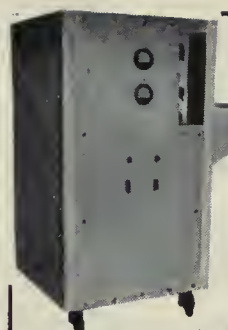
In certain instances where one quality imparted by a wood flour filler is highly desirable, other qualities may be improved by the addition of a second filler. Thus, with experience to guide him, the molder has many possible combinations to achieve required results.

Cotton fillers for the molding plastics, though not extensively used, have certain definite advantages. The impact resistance imparted is somewhat better than with wood flour, but at the same time is inferior to that provided by textile fillers. With cotton, finished appearance of the product is maintained. Cotton-filled plastics are especially noted for their resistance to moisture absorption. Mica-filled plastics, used extensively for parts requiring low electrical losses, may be strengthened by the addition of a cotton filler at no expense to the electrical properties. Use of a cotton filler with the urea-type molding plastics is not recommended due to the effects of the filler on the delicate pastel shades so important to most urea products.

Factors limiting the wider use of cotton fillers are cost and difficulties experienced during preparation. Finely-ground cotton flock has a tendency to clot, thus making impregnation a difficult process. Too, the cost of the cotton flock is considerably more than that of wood flour.

Paper pulp has sometimes been employed as a plastics filler. Finely ground, it is occasionally used as a substitute for wood flour, imparting certain advantages to the molding plastic. The main objections in this case are the impurities contained. Paper pulp is more generally employed in the fabrication of resin-impregnated molding board used for mechanical reinforcement of the molded part. Careful control of the moisture and natural resin content of the paper pulp is important, as either substance will have a direct bearing upon subsequent impregnation with the synthetic resin.

In turning to textile fillers for molding plastics, we encounter the ingredient that has made possible adaptation of plastics products to machine design. The one and all-important factor favoring use of the textile fillers is high tensile and impact strength. The physical composition of the textile fibres which allows for optimum resin impregnation, the strength of the fibres themselves, and the weaving and cross-locking of the fibres in the plastics composition, all contribute to a structural integrity highly desirable in engineering design.



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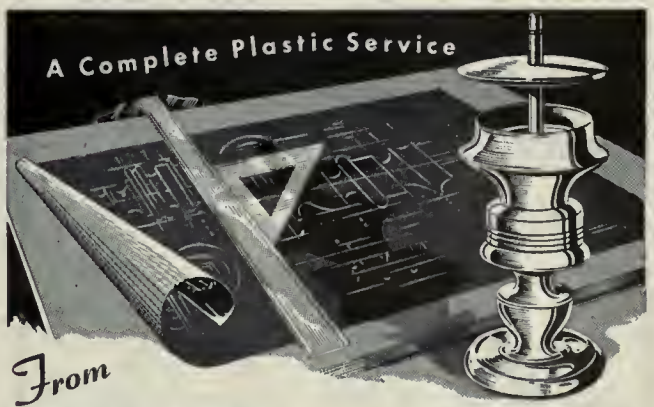

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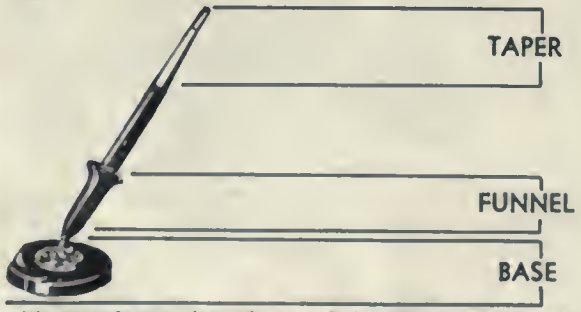

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Classification of Plastics Fillers

ORGANIC FILLERS (CELLULOSIC)
- Cotton
- Wood flour
- Paper pulp
- Shredded textiles
- Corn husks
- Seed hulls
- Alpha-cellulose

ORGANIC FILLERS (CARBONACEOUS)
- Graphite
- Carbon black

INORGANIC FILLERS
- Asbestos
- Pumice
- Powdered mica
- Silicates (glass)
- Barytes (barite)
- Whiting
- Oxides (zinc, lead, calcium)
- Emery

INORGANIC FILLERS (METAL POWDERS)
- Copper
- Aluminum
- Lead
- Iron

MISCELLANEOUS FILLERS (ORGANIC ORIGIN)
- Plasticizers
- Finely ground rubber

Textile-impregnated compositions have found wide application for such articles as molded machine gears, gear housings, couplings, aircraft cable control pulleys, components for oil well drilling rigs and other heavy duty applications. The engineering demand for this product continues to increase.

Textile fillers are a by-product of the textile industry. Clippings, shearings and scrap go into their composition. Despite the fact that demands for the product are increasing, the textile-filled plastics offer certain disadvantages that are generally overlooked in favor of their high impact strength.

Any textile-filled plastic presents a mottled-finish appearance interlaced with a heterogeneous pattern of the filler content. When the molded part requires additional surface finishing, such as sanding or grinding, the filler strands cling tenaciously to the body of the part after the resin has been ground away. This results in a fuzzy, uneven finished appearance. But the greatest difficulty lies in the inferior moldability of the textile-filled compositions. This, however, is being overcome by steady improvements in technique and mold design.

It would be impossible to list in detail all filler-resin compositions and the specific uses of each. In fact, the variety of synthetic resins available coupled with the filler or filler-combinations that have been found practical will continue to be confusing until greater standardization throughout the industry is attained.

It would be well to call attention to the indicated possibilities of blown glass as a plastics filler. Though most glass-filled plastics are still of the laminated variety, built up by impregnating successive layers of glass cloth with a low pressure thermosetting resin, the high strength attained by glass offers distinct advantages to molded plastics as well. Startling but true, the strength of the laminated glass-filled plastics equals and in some instances surpasses that of aluminum alloys! END

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—is the slogan raised in an article bearing this title, to appear in the forthcoming issue of *plastics*. The technique of consumer testing to insure acceptance of products in advance of manufacture is well delineated by Roger L. Nowland, of Van Doren, Nowland & Schladermundt.

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Phenolics Post-War

(*Continued from page* 48)

who created them. As each new problem arose, new formulas or variations of older formulas came into being. Each new set of specifications was promptly met within the limitations of plastics. New fillers that greatly increased their strength were found. Quick-setting resins were developed to hasten production. Resins were prepared which would cure at room temperature, and with nominal pressure so that bigger and bigger pieces could be made without waiting for huge presses to be built.

Pulp molding, which made a small pre-war start, will benefit tremendously from some of these new low-pressure resins in the manufacture of packaging containers. Two methods of pulp molding are advancing rapidly with promise of practical application in many products: One is to whip long fibres into the resin mix in a paper beater, then withdraw them by vacuum onto a screen of the approximate shape of the part to be molded. In this way, fibres take the contours of the piece naturally and are less likely to break when squeezed in the press. The rough shape is removed from the screen and allowed to dry; then it may be pressed by high or low pressure as the piece demands. The fibres give strength to the phenolic binder because they remain in continuous unbroken lengths even around sharp radii and much longer fibres can be used.

It is possible to mold very large pieces by this method with low pressure phenolics. Aircraft parts, canoes, duck boats and other pleasure craft have been experimentally molded and results are good. Their application will be limited only by the ingenuity of designers and manufacturers to work out the most practical things to be made where the advantages of phenolic resins increases and prolongs their use in service. In boats, for example, no caulking is required. There are no seams to open; no boards to split or shrink; and the smooth hard surface glides through the water swiftly and easily because barnacles have no place to hang on.

The other method of pulp molding is accomplished by impregnation after the pulp has been formed and dried. A rapid impregnating resin is desirable and the part may be brushed, sprayed or dipped. The lower the solvent content of the resin, the more rapidly the part can be molded because there will be less solvent to drive off in the curing operation. Both pulp preform and mold must be carefully designed because the walls of the preform must be compressed evenly during molding in order to maintain uniform strength throughout. Pulp containers are not new. They have been used for egg crates, bottle protectors, window displays and many other things. Given the combined strength of long fibres and phenolic resins, they become an entirely new product capable of many new applications. It is predicted by some that console radio cabinets and equally large pieces of home furnishings and kitchen equipment are possible by this method although a good deal of trying and testing remains to be done before ultimate results can be determined.

Not much has been said about it but extruded phenolics in continuous lengths are not far around the corner. These will provide conduit pipes which may be buried underground without danger of corrosion. They can be threaded like metal pipes and conventional fittings of phenolics will hold them together. As size limitations are overcome, huge phenolic interliners will protect concrete ducts from destructive liquids and gases and add years to their useful service. Extruded sheets and other cross sections will follow as equipment is perfected and a wide variety of fillers will give an equally broad range of properties in

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industrial applications. With new phenolic cements which bond plastics parts into practically homogeneous units, it is easy to foresee window and door frames made from extruded members which will neither stick nor sag. They will open easily and close tightly over the years without swelling or shrinking like wood. Channels will be uniform throughout, factory fitted to save time, and they will prevent seepage of moisture, heat and cold. Screen doors, built with extruded phenolic frames and screened with synthetic fibre mesh, will last as long as the house.

A good many of these improvements in resins and methods extend beyond the realm of molded products into casting and laminating which will be discussed later on. The immediate point to consider is that plastics, now more than ever, are custom built to meet specific industrial needs. Manufacturers with post-war plans taking shape on drafting boards throughout the country cannot afford to overlook this fact. No one can profitably trust his memory of plastics, especially phenolics, as he knew them pre-war. They are as different today as his markets will be tomorrow when he meets the public again after working so long for Uncle Sam. END

Coated Fabrics

(*Continued from page* 58)

butyral, a thermosetting type, was a "natural" for them. This resin is the only one of the vinyl family that makes use of all the rubber making equipment, mills, calenders, and curing equipment. It is therefore being widely and successfully used by the rubber-coated fabric branch of the industry.

Polyvinyl chloride and its copolymers are also being calendered, but since they are tougher resins and require higher operating temperatures, the technique of processing as well as the proper coating formulation, was more difficult to acquire. However, these initial difficulties were overcome and these resins are being successfully used in volume. The calendered coatings are heavier than the spread coatings, but the increased consumption of resins and plasticizers is offset by saving on solvents.

In addition to the vinyl resins, the synthetic rubbers, *Neoprene, Buna N, Buna S* and *Butyl,* are being both spread and calendered on fabrics. *Neoprene* was applied by these methods before the war, but it has become more widely used during the past two years. Having many of the qualities of natural rubber, *Neoprene* has been restricted to

Navy utility cover made from synthetic resin-coated fabric—one side is identification yellow, the other, camouflage blue

those products requiring its specific quality characteristics and considered highly essential. *Buna-S* and *Butyl* are now being more extensively coated as they have become more available recently. *Buna N* is still not available except for coatings with the highest priority rating.

The most important coating materials being used today are alkyd resins, vinyl resins, including polyvinyl butyral, *Neoprene, Buna S* and *Butyl,* with other resins and synthetic rubbers playing a secondary role.

These coating materials are being used at present because: *first,* they are the most readily obtainable; *second,* they are most adaptable to existing processing equipment; *third,* the coated fabrics made from them can be fabricated efficiently with existing equipment; and *fourth,* these coated fabrics possess the proper quality characteristics in the highest degree.

In arriving at this group of fabric-coating compounds the fabric coating industry, as a whole, screened every film-forming material that offered a possibility of meeting military requirements, and industry has not yet let up in their efforts. They are continually evaluating new coating compounds which will improve their war products or eliminate potential bottlenecks in processing and fabricating. They are experimenting with emulsions and dispersions of vinyl resins which would eliminate critical solvents. The rubber-coaters are busy improving the compounding and processing of the *Buna-S* and *Butyl* synthetic rubbers to take advantage of the improving supply situation.

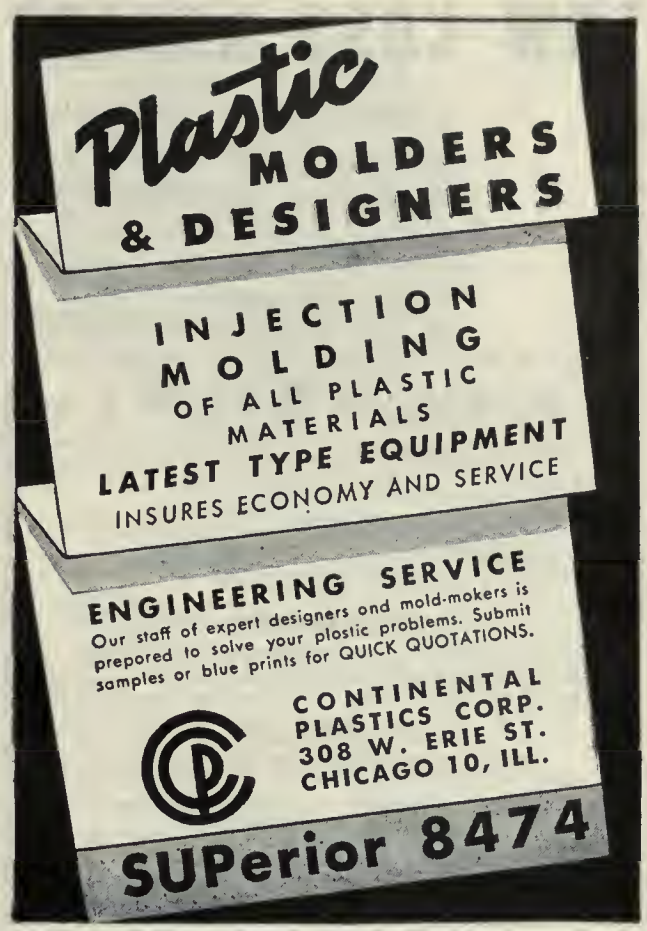
The post-war prospects for the heavier weight coated fabrics indicate that the furniture, footwear, and automotive fields offer the best possibilities. For the light weight coated fabrics the best outlets appear to be garments, umbrellas, hospital and crib sheeting and household accessories such as shower curtains, garment bags, food covers, etc. However, these light weight, resin-coated fabrics are going to have competition from another plastic —unsupported, plastic film. Elastomeric film was becoming rather well established in this industry before the war. Military demand for unsupported film has resulted in the development of films of improved qualities which will have a wider range of usefulness in the post-war period. The capacity for manufacturing film by extrusion, casting, and calendering has expanded greatly and the "know how" of fabricating articles from film by heat sealing has been widespread. Vinyl resins are the principal film-forming materials being used today and they appear to have the proper characteristics for the uses mentioned above. However, other elastomer resins are being evaluated which give promise of being applicable. END

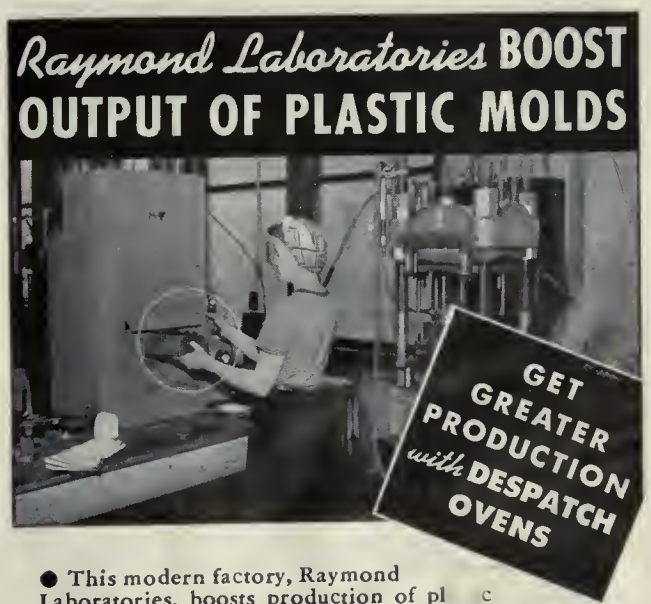
Melurac

(*Continued from page* 40)

procedure was then tried out with melamine adhesives and urea resins in the hope of producing a more economical product having the noble properties of the melamine adhesive. The effect of small additions of melamine to urea resin adhesives may be seen in Tables 1 and 2. With a much greater addition of melamine, a new adhesive has been devised which not only is comparable in boil resistance and durability of bond to the melamine adhesives, but which, in addition, possesses many of the advantages of urea adhesives.

This adhesive, consisting of a melamine-urea-formaldehyde resin with a suitable filler for woodworking applications, is called *Melurac.* It is supplied as a free flowing powder which, when properly mixed with water, produces a glue mix of exceptionally strong, non-staining, boilproof bond at moderate press temperature. It can be used advan-





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tageously for assembly glueing wherever heat can be supplied to develop the boil resistance of the bond.

For hot-press work at platen temperatures from 220° F to 260° F, the simple water-resin mix provides extraordinary ease of operation since the working life of the glue is more than 18 hr at 70° F, and spread panels can be retained almost indefinitely before assembly and pressing. *Melurac*-bonded plywood has exceptional secondary glueing properties since there is no strike-through of the glue, even on the thinnest sound veneers, and the press temperatures are so low that case-hardening is practically impossible.

This adhesive also has been accepted for bag molding, as its low cure temperature imparts longevity to the expensive rubber bags. Since generally greater flow is required for this operation to provide the necessary slip for positioning of veneers when the pressure is applied, it is wise to store spread veneers at about 65% relative humidity.

There are many cases where it is desirable to provide a really durable, boil-resistant bond in assembly work. Wherever it is possible to apply heat sufficient to bring the glue line to 220° F, the regular water-resin *Melurac* mix can be advantageously used for this type of joint work. Where such heating is either inconvenient or impossible, the addition of 0.5% of ammonium chloride (based on the dry content) provides an adhesive which can be cold pressed, clamped and kiln cured to provide a boil-resistant bond. Laminated skiis have been made in which this adhesive was cold pressed, and the ski blanks after removal from the clamps were subjected to a 24 hr kiln cure at 140° F. Perfectly boil-resistant bonding was achieved. For general work a kiln treatment of 16 hr at 160° F is recommended.

Many peacetime applications are in view for this new adhesive, which is now widely used in the fabrication of aircraft plywood and many aircraft and marine sub-assemblies. It is already in use in the edge glueing of fine veneers and it is being applied to postwar plans for the edge glueing of lumber for fine furniture, which is to be finished by application of baking finishes. The fact that it provides the greatest durability and does not stain fine woods makes it very attractive to the producers of fine decorative wood assemblies. END

Your Molder Can Help You

(*Continued from page 24*)

jobs which are beyond the size range of standard injection-molding equipment.

The greatest commercial usefulness of the compression method is reached in the molding of thermosetting materials. Here the mold can be maintained constantly at normal molding temperature, usually in the neighborhood of 350° F. The mold is charged with a measured amount of plastic material—either a compressed preform or loose powder. The mold is then closed and pressure applied. After a predetermined curing time, usually 1½ to several minutes, the mold is reopened and the molded piece removed. In general, compression molding of thermosetting materials is a rapid, economical process.

Certain types of thermosetting parts cannot be molded economically by compression—notably, those in which there are small fragile pins or other relatively weak mold sections. In compression molding, when the mold is closed, the thermosetting material has not yet reached a state of maximum plasticity, so that when pressure is applied, it moves to fill out the mold with such force that it is likely to break off relatively fragile mold sections.

To overcome this limitation of compression molding, an alternative method, known as transfer molding is employed. In transfer molding, the mold cavity is closed

at the time of charging. The thermosetting material—usually a preheated preform—is loaded into a separate loading chamber known as the "pot". Then, as the press is run up, a plunger forces the plastics material through sprues into the closed mold cavities.

By the time the material has flowed through the sprue and into the closed mold cavity, it has been heated to the point of maximum plasticity, and in a properly designed mold, will flow freely around pins and other comparatively fragile mold sections. Full molding pressure does not take effect until the cavity has been completely filled. Thus, the weaker mold sections are supported by equal pressure from all sides.

Although transfer molding has been widely used for many years, wartime applications with their need for intricate shapes and close tolerances, have brought this process into wider use than ever before. It has proven particularly valuable in handling the more difficult extra-strength materials.

Most transfer molding jobs today are being produced on the standard type of single-ram compression press. The best results, however, are obtainable from double-ram presses, in which one ram exerts holding pressure to keep the mold closed while the opposite ram performs the job of transferring the material to the closed cavity.

Newest and most rapid of the commonly used molding processes is injection molding, ideally suited to the molding of thermoplastic materials, and used for by far the greater percentage of the thermoplastics parts produced today.

In the injection press, the material is fed from the loading hopper into a chamber, in which it is heated to the point of plasticity; then injected by means of a plunger through the nozzle and sprue into the closed cavity or cavities of the mold. The mold itself is cooled by water, and the molded pieces can be removed as soon as they are hard enough to retain their shape. The molding cycle is therefore very brief, and production is rapid and economical even from small, one or two cavity molds.

The principal limitation of injection molding today is in the size of the available equipment. There are few presses in existence with a capacity greater than 12 to 16 oz. There is every reason to expect, however, that when the demand for larger thermoplastic parts becomes sufficiently great, presses of greater capacity will be built and put into use.

The technique of compression and injection molding is difficult and may be learned only through long experience. A list of "do's" and "don'ts" on choice of materials and design of molds will not do one bit of good unless you follow through by getting an expert to help you with your molding problems. Choose this expert by his reputation and his equipment and discuss your job freely with him and you will be on safe ground. END

Merchandising Plastics Products

(*Continued from page 75*)

plastics used had more porosity than metal, thus permitting the lipstick and cosmetic stains to discolor the case. In this case the manufacturer should have conducted research and advised the designer that it was necessary to keep the color of the case in a darker color range that would not show stains so readily.

For plastics that are used in the household, post-war offers an exceptionally bright future to those items sold in volume by chain stores. Again, the wise manufacturer will run exhaustive tests on his items before he begins volume production, to make certain that they will give the ultimate user full value. "Full value" means simply that

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the product will stand up under abuse as well as use. It cannot be forgotten that plastics resemble metal or glass, that housewives have become accustomed to handling certain utensils in certain ways. What under normal circumstances is a perfectly satisfactory thermoplastic gadget may be subjected to immersion in hot water. The result will be a ruined product and another black eye for the industry. Thus, if there is any possibility that a product will be ruined through misuse, or if it requires attention and care out of the ordinary, it is best to attach complete instructions for its use and care. Such precaution will give the retailer a logical weapon to combat unwarranted complaints.

The average chain store is interested in building repeat sales by catering to customers with staple items. Plastics have proved themselves in this field. Why not, therefore, shy away from production of novelty plastics, which invariably associate the material with a certain feeling of instability in the consumer's mind, and instead create an acceptance for plastics as a base material by linking it with well-designed, well-made, serviceable and practical consumer items? Nothing the plastics industry could do collectively would produce greater benefits.

The industry should not continue to offer plastics as an "ersatz" material or associate it with "ersatz" merchandise. Syndicate store managements have run up the red flag warning buyers to ease off merchandise that smacks of war-time substitutes. They know that John Q. Public will expect at least pre-war quality the day the armistice is signed and they have no intention of taking markdowns and losses on non-saleable merchandise. The wise plastics man has already heeded these warnings.

The war has afforded the industry an excellent opportunity to take inventory of itself and to determine its weak as well as its strong points. Syndicate managements have watched with interest the procession of new basic materials that, from time to time, have been introduced as the final answer to all fabrication problems. The last two decades have seen the mass production of steel, which promised to be the answer to all problems of fabrication. Yet today we still employ wood, glass and other basic materials in our manufacturing because steel does not meet all product requirements.

Closely upon the heels of the steel boom came the aluminum boom. During the early 20's designers filled the pages of magazines and newspapers with plans for reconstructing the world in aluminum. That too failed because, while it was entirely possible from a manufacturing standpoint, it was highly impractical from a use standpoint.

Today plastics are capturing the public's imagination with promises of plastics clothing, plastics furniture, plastics this and plastics that. Tongue in cheek, the chain store "boys" know that plastics won't revolutionize the world. The chain store buyer will of course "sample" anything that looks good or practical—but that "sampling" should not offer too much encouragement to plastics designers and molders. The fields plastics will dominate will still be those in which they are best suited to the job.

The ultimate future of plastics in chain stores is tremendous because they are ideal for mass production at low prices.

With the imports of cheap products from pre-war Germany and Japan shut off for the duration-plus, the plastics industry can fill an important niche in the supply structure of the syndicate stores. In the case of chain stores, however, the manufacturer can't afford to experiment at the expense of the retailer, for the simple reason that there are relatively few major syndicates. Unlike department store selling, if one antagonizes and loses the patronage of one large chain of stores, a major share of the market is gone.

Last, but not least, there can never be a fruitful liaison between the plastics industry and chain stores until plastics manufacturers learn the importance of concentrating on doing one job well. Not that they must be like the specialist who makes only left-handed salad forks, but syndicates have enough to worry about without contending with suppliers who make anything from an elephant howdah to a mustache cup, just because some other fellow is making them. The only one way to grow big, in the eyes of chain store buyers, is to know a particular job and watch it, instead of worrying about the other fellow.

In planning plastics products for chains, it is well to remember the importance of product simplicity. The simpler the product, the easier it is for the prospective purchaser to understand its use and the more readily it will sell. "Over-merchandising" by adding non-essential gewgaws to a product in order to outdo one's competitors, may end up in outdoing one's self.

Quality, too, is paramount. A 50c compact is no good if it leaks powder or won't close properly. A chain store would sooner sell fewer compacts of a better quality and know that it could promise its customers satisfactory service and build repeat business. Utility and satisfaction in use is another important check-point in planning a plastics product. One can often increase the utility of a product by combining metal or wood with plastics.

Good design and styling are also vital. Although one's primary attempt should be to get good functional design, where the product's appearance is important, as in a compact, good styling is of first importance.

Packaging

Recogn.tion should be given to "impulse" purchasing by customers. This calls for thought in packaging a plastics product so that it makes a favorable appearance on the counter, permits good display of the item, and presents a complete and easy-to-understand story of its properties and uses on the package. Packaging may range from a sticker on the merchandise to a de-luxe gift box, but whatever it may be, it must meet the requirements of good display, ease of stockroom storage and protection in shipping.

Finally, a product needs good advertising. Just because it is sold in chain stores doesn't mean that it need not be made to stand out in the public mind. During the last few years the value of branded merchandise has become more and more apparent in chain stores. Consumers have been loathe to accept "just-as-good-as" substitutes and the result has been a roving consumer trade which has created many headaches for retailers who had what they thought was an established clientele. These retailers found that the quickest way to woo back the affections of ex-customers was with branded merchandise that has consumer acceptance in advance. Molders, when figuring costs, should permit themselves an adequate margin to do a thorough and sound consumer educational and goodwill job through the medium of advertising. Only in this way will any one plastics product or line become indispensable.

In addition to a sound advertising and publicity program on plastics products, the manufacturers of plastics powders should give thought to creating brand consciousness for the raw material itself. The use of distinguishing colors or some other device can protect and individualize what might otherwise be an unrecognizable value.

Will the chains be hesitant about purchasing something new just because it is made of plastics? Not at all; they have been leaders in pioneering both merchandise as well as merchandising methods. Chain stores are not asking for favoritism, merely the assurance that the molders, designers and merchandisers of plastics products will employ principles that should be applied to any sound, well-established business. END

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What's Wrong with Molding Machinery?

(*Continued from page 66*)

they had served other needs. On the other hand, the injection molding machine was created solely for molding plastics. The designer may have inherited some fundamental ideas from die-casting engineers, but started largely from scratch. They have done a fairly good job, but there is still room for improvement.

Injection machines should be self-contained. It should not be necessary to mount temperature controls on a wall. Frequently it is desirable to place the machine in the middle of the room, where no walls are available. Because the machine manufacturer has not provided the vital temperature controls as an integral part of the machine, molders have had to mount these on the machine with rubber shock mounts, as shown in Fig. 2. Here the temperature control is mounted on the back of the switchboard, which is raised to eye level and mounted on the pump end of the machine. The shock mounts insulate the delicate instrument from the vibration of the press.

For production work, it is desirable to keep an accurate record or the number of cycles of the machine. Note the electric cycle counter mounted under the temperature controller in full view of the operator, who can constantly watch his production progress. In some cases the electric counter is built into the machine by the molder (Fig. 1).

Some electrical switchboards are so placed that oil can leak into the controls. This fouls the contacts, which burn and fail to close the circuit; fires often result from leaking oil. Placing the switchboard in a more suitable location would entail no special difficulty and would also eliminate the existing hazards.

The newly-designed switchboards described above are enclosed in oil and dustproof boxes and mounted on the machines where they are accessible. The circuit has been changed to remove some safety hazards, is operated by a magnetic pushbutton-controlled switch, and incorporates a contactor for the heaters, operated from the temperature control.

The safety devices on injection presses are sometimes inadequate. On one machine, a relay was used as a locking-out means for the injection stroke. Failure of the relay caused repeating of the stroke, creating a condition which could result in injury to the operator. When locking-out relays are installed in a circuit, they should be wired so that the machine cannot function if a relay fails.

Also of importance is that safety gates should release oil pressure down to pilot pressure to prevent any possibility of press closure with the gates open.

With electric power at a premium, and as a war aid, wattage must not be wasted. Heating cylinders for injection machines use up to 5 kw, generally taken from one side of a 3-phase line. The wiring is inside the machine

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and always on the same side of the line. Consequently, the use of several machines unbalances the circuit badly.

The author has designed 3-phase contactor on the main switchboard. As a result, power factor has now climbed to 0.92. The power company charges extra for power factors below 0.75, and discounts the bill for power factors above 0.85, thus producing substantial savings.

Because of changing power requirements during various parts of the molding cycle, the power factor fluctuates. Corrective condenser can be used to cut down the amount of this fluctuation.

Power Conservation Important

Still another change should be made by the equipment manufacturer to conserve power. It is customary at present to have the pump working at full pressure throughout the cycle, spilling the pressure out through a relief valve when the plunger is not in the forward position. This is wasteful. The manufacturer should install a means of relief so that the pump pressure could be reduced to 75 or even 50 psi during a portion of the cycle, thus saving much power. With the proper corrective condensers, a high power factor could still be maintained.

Another observation: many streamlined housings of injection presses are eye appealing; but are not practical when the mechanic must make adjustments inside the machine.

Some stock hoppers are placed so high on the machine it is difficult for operators, particularly female, to put the stock in. On one recent machine the hopper is 11 ft from the floor and when the machine manufacturer was asked how to fill it, he said: "Fill it from the second floor"! This shows how little the machine manufacturer considers the molder's problems—most of the molding plants are in a single-story building or have other things on the floor above which make this impractical.

Another difficulty is caused by the inaccessible positions in which the gate to the stock passage is placed to permit the operator to return the sprues to the heating cylinder. One machine has this opening in the back of the machine.

The author has seen machines as much as 1/8" out of line between the platens and heating cylinder. Molds are made to exacting limits and the machines to run them should be expected to have at least as much accuracy as the molds.

Some machines require the removal of strain rods to put the molds in place. Others have a knockout mechanism which is not strong enough to strip the molded parts. Some must be torn down to replace parts such as link pins, which break frequently.

The poor repair service given by some machine manufacturers is another source of grief. One of our machines recently stripped a coupling between the motor and pump. The machine manufacturer was contacted immediately, as the press held an important war job, and could not operate without the coupling. The manufacturer said he would be unable to ship a coupling for 4 months, since all available couplings were scheduled to go into new machines! Faced with the prospect of keeping the machine idle for a third of a year, we turned to a manufacturer of entirely different equipment who used a similar coupling. The following day the machine was back in operation.

The author has found through inquiry that most other molders experience many of the same difficulties that are mentioned in this article. In plastics as in other industries, this situation points toward the need for increasing cooperation between molder and machine manufacturer in order to iron out the numerous problems which have arisen through the use of present equipment. Only in this fashion can the whole industry advance at its optimum rate. END

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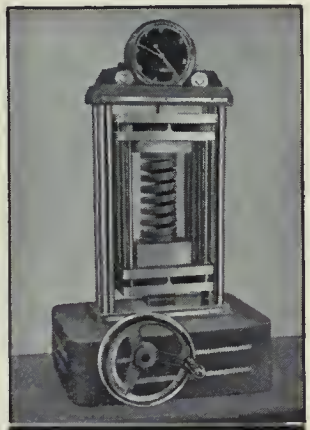

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What Price Performance?

(*Continued from page* 68)

Then, there is in Column 4 the Manufacturing Conversion Factor. What does this mean and why is it important? Not only is it important to know the cost of a material itself, but the *methods* of manufacture also contribute a major item of the cost of the finished article. They influence labor, overhead, tool and equipment charges. So do attachments, etc. Appreciable differences in these costs will result from the *design* of the particular product under consideration, but in order to arrive at some insight in the relative merits of different materials, we take a bold step and estimate an *average* additional cost for each manufacturing process, as a *multiplier* of the raw material cost. This is the manufacturing conversion factor.

In Column 5, we find the cost for an equal volume of *finished product* in each material, arrived at by multiplying Columns 2, 3 and 4. This gives the cost for 27.8 cu in of each material (27.8 cu in per lb being the specific volume of water with a specific gravity of 1). The number of cu in of each material being equal throughout Column 5, multiplication of Columns 2, 3 and 4 gives a strictly comparable cost factor for all materials. It is unnecessary to develop costs per 1 cu in, because the method is being applied uniformly. Those who figure in that manner need only divide Column 5 by 27.8.

Costs per cu in are essential, because we measure major properties of performance, like tensile strength, flexural strength, etc., in psi and not per lb. Costs per cu in *eliminate* the extra calculation involved in bringing the material thickness required for a satisfactory design down to weights and prices per lb. Many times a true picture is attempted by giving $\frac{\text{performance}}{\text{spec. grav.}}$ but inasmuch as we are investigating performance *per dollar*, it is more logical and quite a bit faster to quote prices in *dollars* × *specific gravity* and take the performance at its actual value!

Columns 6, 7, 8 and 9 are self-explanatory but attention should be given the need for *standard* test methods for all materials. If the test methods used are not in conformity considerable differences in these figures can result with an apparent distortion in the results of an analysis based on this type chart.

In Column 10 are given the maximum temperatures up to which the materials remain stable, which factor is of equal importance to the constancy of the dimensions of our products, as is Column 9, Water Absorption.

Column 11 gives the Rockwell hardness on the M scale to denote the surface characteristics of these materials.

Column 12 denotes the relative insulating characteristics for electricity of these materials and we may add many other columns with factual data regarding chemical resistance, aging properties, color possibilities, etc.

Now, in interpreting these figures, costs and water absorption should be minima and other performance data

should be maxima for the most desirable material. Therefore, the material showing the highest quotient of performance over cost should be the proper one to use in an application under consideration, provided proper emphasis is given to the one or two salient characteristics required for the proper functioning of this part.

For example, where highest impact is required, combined with lowest water absorption, the quotient of Columns 8 and 9 reveals stainless steel in the metals group and fibre-glass-no-pressure laminate in the plastics group as outstanding materials. Now if we consider no other additional requirements for simplicity's sake, and look at the costs, the factor $\frac{\text{cost} \times \text{water absorption}}{\text{impact}}$ should be a minimum to arrive at the most economical material of these two. This quotient is $\frac{840 \times .1}{28} = 3$ for stainless steel and $\frac{370 \times .4}{15} = \pm 10$ for fibre glass plastics, demonstrating a higher efficiency for stainless steel on the basis of impact resistance and water absorption *alone*. Obviously many more factors are usually in the play, such as electrical or heat resistance, surface characteristics and chemical resistances, and these will allow a much sounder conclusion than this example, limited to three considerations only.

Another point is that certain factors like, for example, the flexural strength, are not in *direct* relationship with costs. To make this clear, obviously one can use twice the wall thickness for the same ultimate product cost when employing a material that is half the cost of the next one per cu in. Now if one makes a beam supported on two ends in the low cost material, twice the height of the one in the higher priced material, it is obvious that the flexural strength of this beam has not been doubled but quadrupled. Flexural strength increases with the square of the height of a beam.

The reader will use his own judgment as to the relative importance of individual factors. E.g., he may in his particular industry wish to give special emphasis to one particular factor by squaring all the figures in this column and using those data in his cost-performance formula.

We would like to underscore that this chart is only the beginning of a system that can be diversified extensively to meet individual requirements. Especially the manufacturing conversion factor will vary widely from product to product and we have attempted to strike only an average.

Essentially this method is *a reduction to mathematics of product designer's common sense*. The story told by the figures, however, will be a revelation in a good many instances. Once the system is set up in accordance with the requirements of a particular industry, it makes for correct selection of raw materials almost at a glance. However, the chart is not intended to replace sound reasoning, by an automatic formula and as is the case with any "tool" it is only as good as the man who uses it. END

An outstanding feature in the December issue of *plastics* will be:

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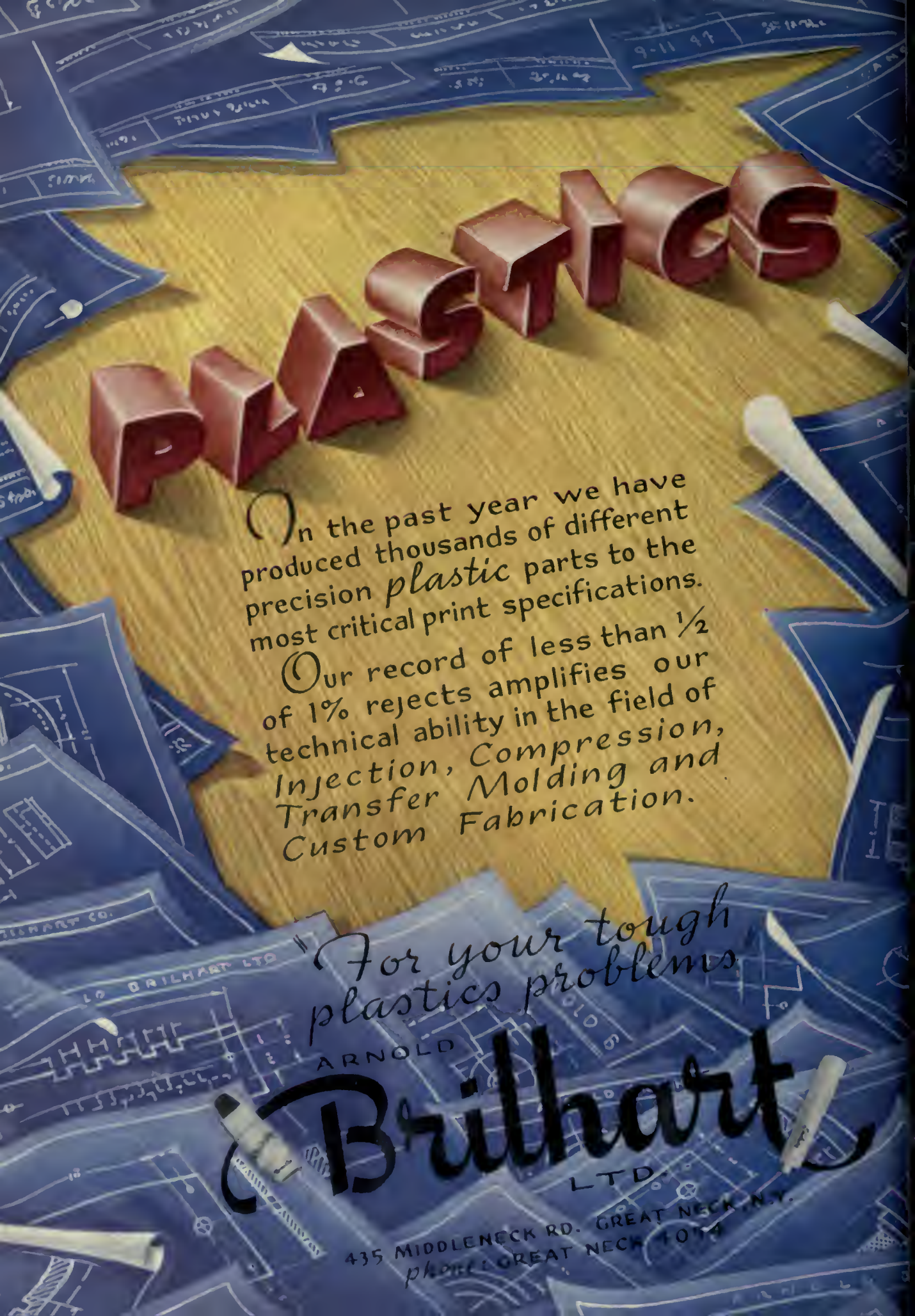
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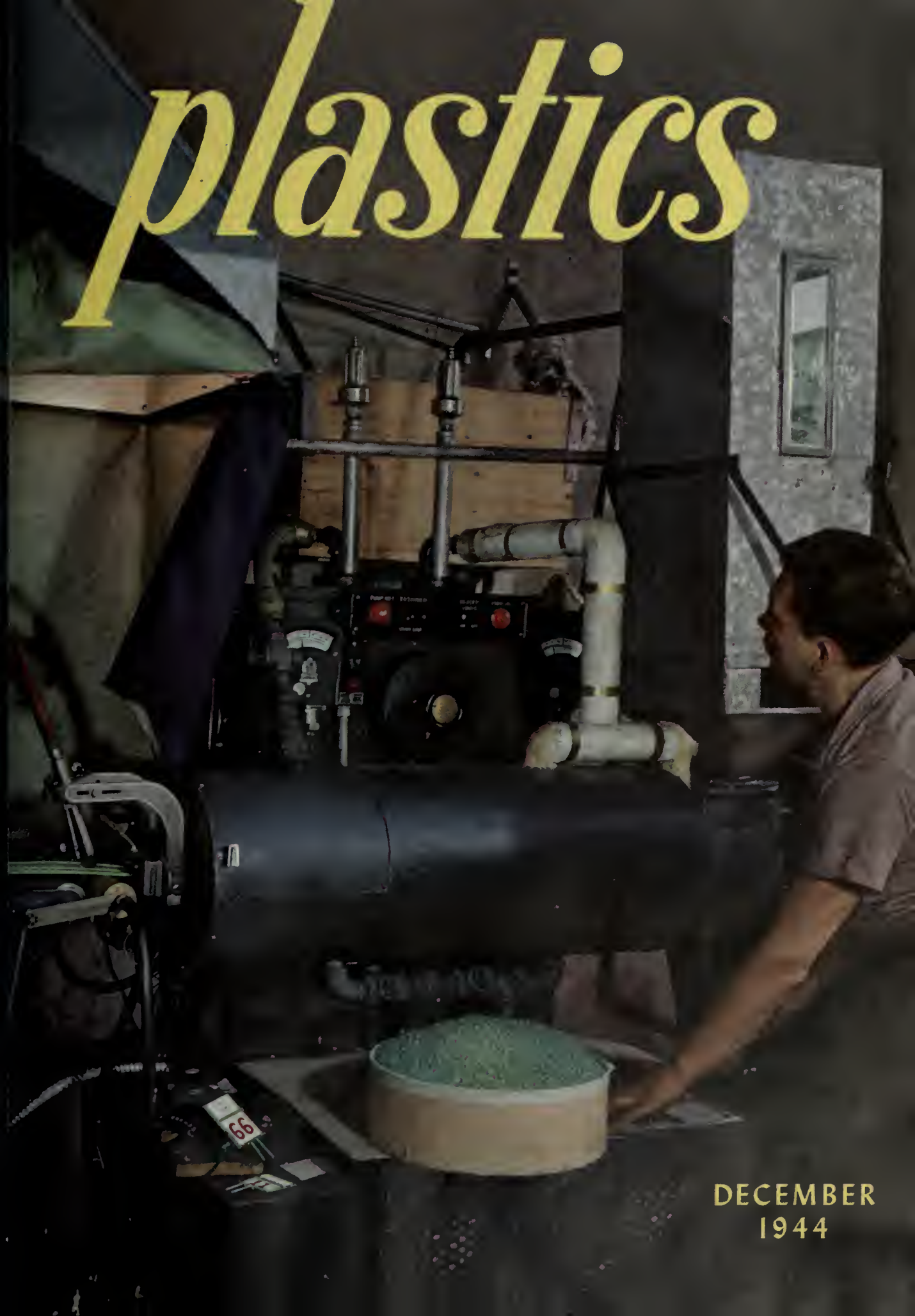

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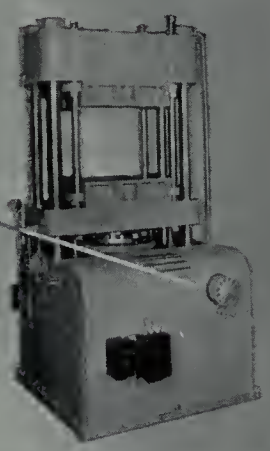

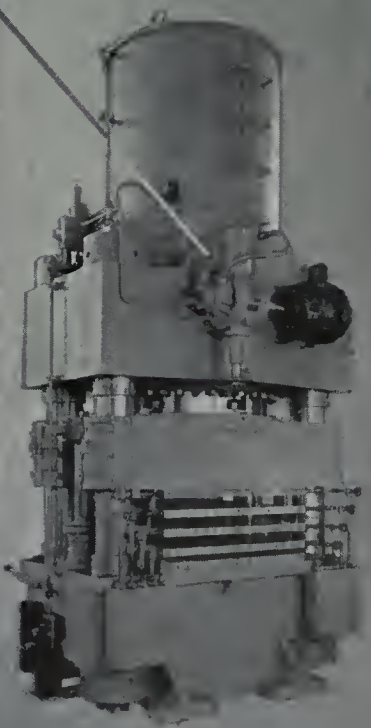

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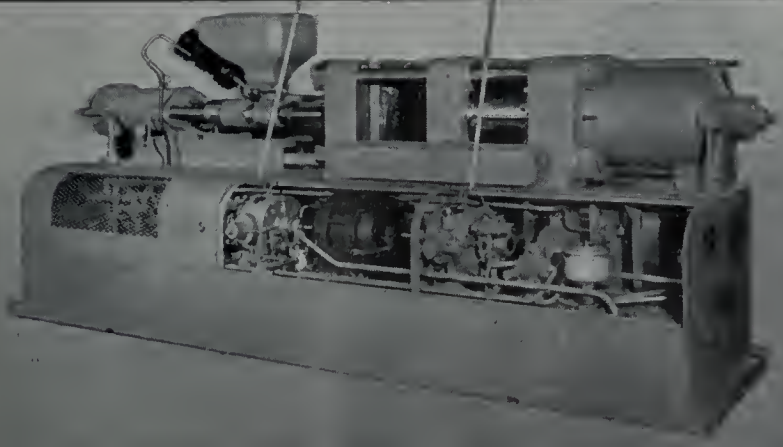

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FRONT COVER: Converted from the molding of rubber to the extrusion of plastics, this National Rubber Machine Co. unit is shown extruding plastics trim at Hopp Press, Inc., New York

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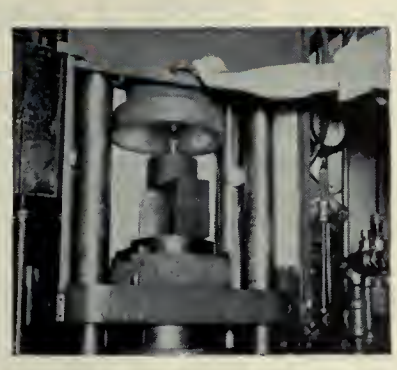

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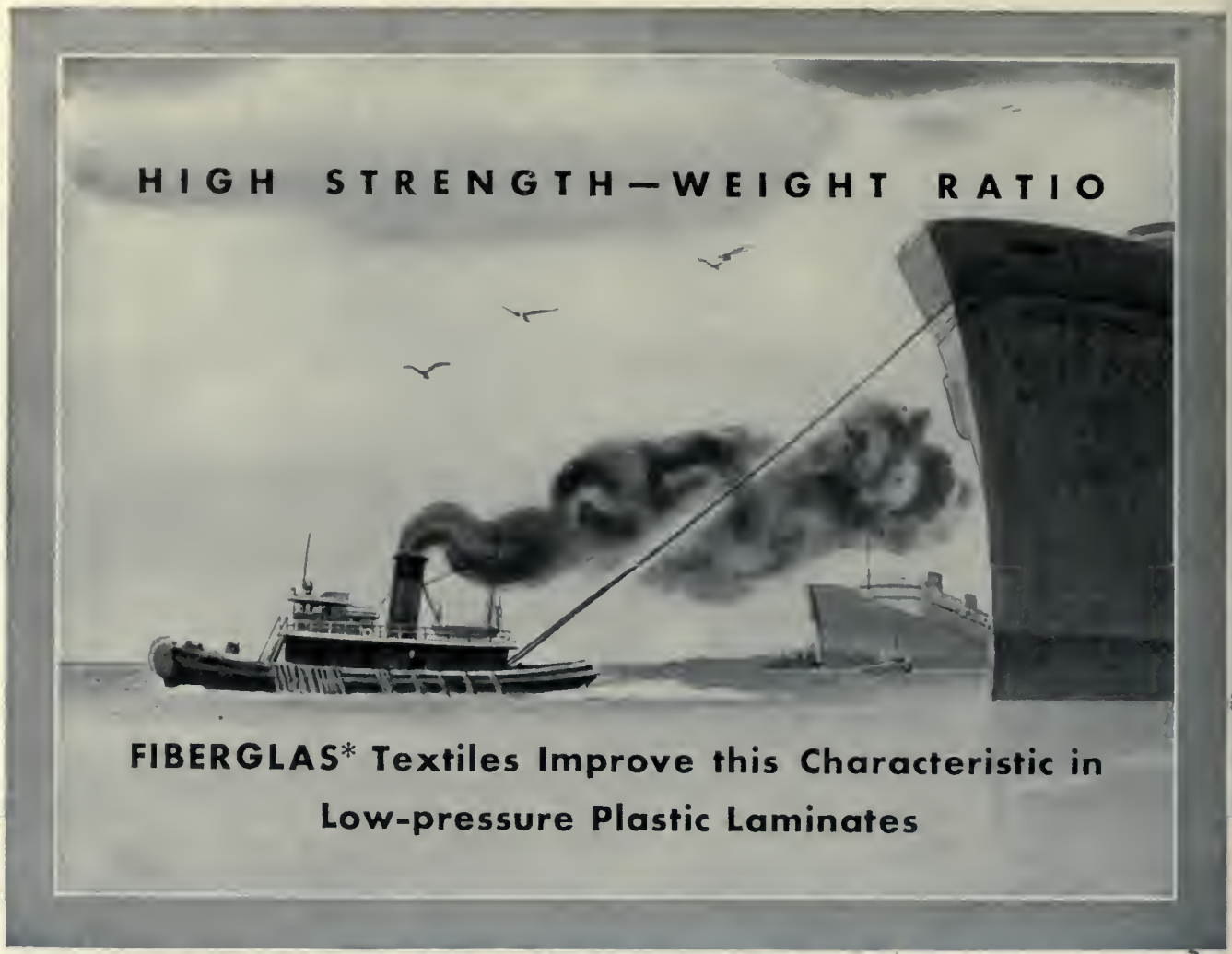

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Fiberglas . . . glass in the form of fine fibers or filaments . . . has a specific tensile strength beyond that of steel. Twisted into yarns, woven into Fiberglas Cloth and put into plastic laminates for reinforcement, Fiberglas carries its high strength with it. Fabricators are producing laminates with strength-weight ratios in excess of those of the high-strength metals.

And they are reporting that Fiberglas Cloth contributes in an important way to other desirable properties in finished laminates, such as impact strength, dimensional stability, moisture resistance.

If you are working to build up strength-weight ratios and other qualities in plastic laminates, you may find it highly profitable to look into Fiberglas Cloth and the results that are being achieved with it in combination with some of the new resins.

As a first step, write for reprints of published reports of comprehensive investigations of Fiberglas-reinforced, low-pressure laminates by the U. S. Army Air Forces. Address your request to *Owens-Corning Fiberglas Corporation, 1881 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

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In the near future there will be parts of your products that should be made of plastic. Which plastic to use? How to mold for satisfactory results? Those are the questions Amphenol can answer.

Designing, experimenting and testing plastic parts have been on Amphenol's daily program for years. Thousandths of an inch tolerances are common in Amphenol's exacting production.

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Many a product is being piloted "on the beam" to bigger and better market opportunities with Mosinee Paperology "at the controls". In much of the same manner that metallurgists create alloys resistant to acid, rust, stain or corrosion . . . alloys of specified hardness, toughness, pliability, density, spring, weight, color, etc... Mosinee Paperologists develop "special analysis" papers to meet a wide variety of industrial product and packaging requirements.

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The success of many plastics depends upon paper made to a specific formula with positive control of chemical and physical properties. Products and parts made of Mosinee frequently represent improved quality and utility. Costs are reduced . . . markets expanded.

Mosinee can be engineered to work better in your processing machines or packaging equipment . . . minimizing delays, work-stoppages and manpower losses, reducing maintenance costs, lowering production costs and boosting output.

Mosinee Paperologists are ready to work on your present or postwar problems.

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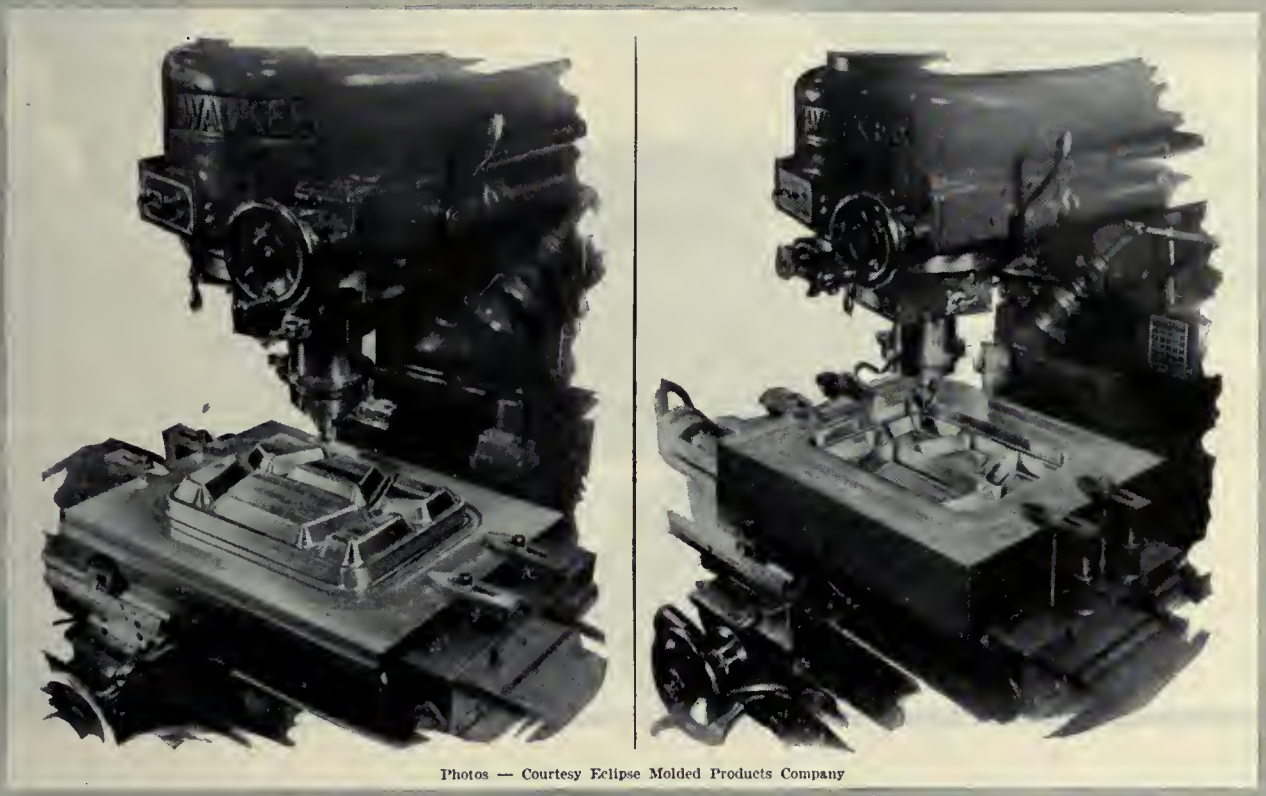
Please address your letter "Attention Dept. E"

How would you handle this Job in your Shop?



Photos — Courtesy Eclipse Molded Products Company

1001-PC

Molds for plastics pose some tough milling problems occasionally. Here's a tray mold — that could have been difficult, but it was completed on a Milwaukee Rotary Head Milling Machine with typical speed, economy, and accuracy.

Read this job report —

TRAY MOLD

CAVITY SIZE — width, 12 inches, length, 15½ inches, depth, 1½ inches.

Time required for milling both mold halves complete — 219 hours.

All form cutters milled to correct size and shape on the Milwaukee Rotary Head Milling Machine.

Check these advantages of the Milwaukee Rotary Head Milling Machine and how you can benefit from them in your own shop:

DIRECT . . . mills mold cavities in a single set-up without the aid of templets or models.

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Write for Bulletin No. 1002C and complete information.

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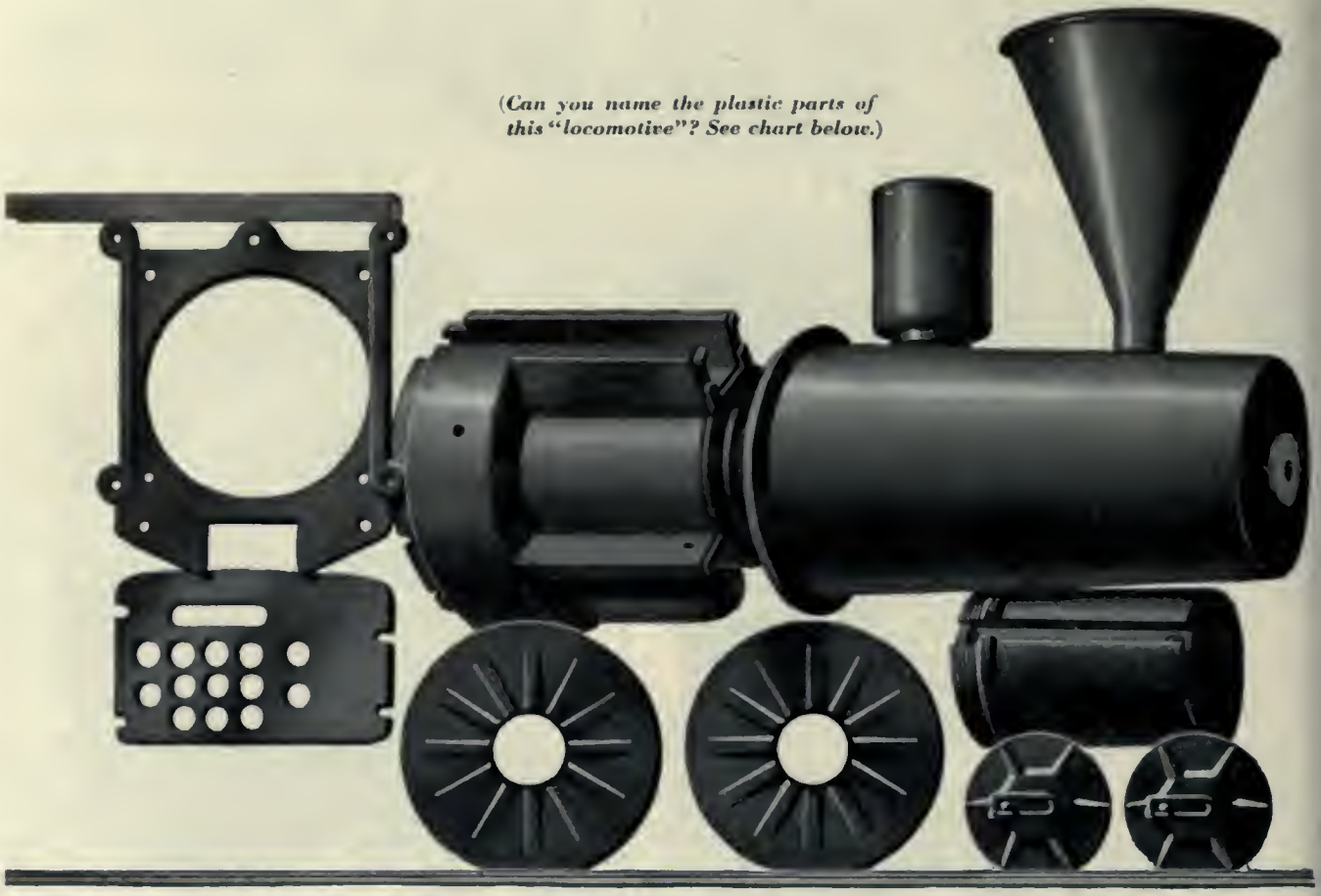
(Can you name the plastic parts of this "locomotive"? See chart below.)



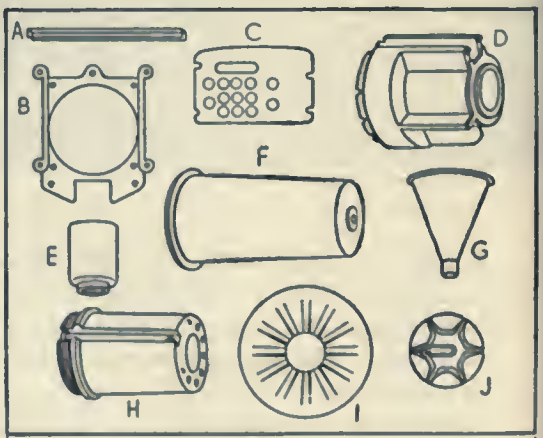
How to put your product on the right track

Steamed Up over improving an old product or introducing a new one? Just whistle and Continental's Plastics Division will be glad to help you get the most pull out of that product.

Our engineers, designers and research men work closely with the leading raw material manufacturers, and have immediate access to all latest developments.* Our long experience counts when it comes to giving your product the qualities it needs—whether beauty, durability, toughness, lightness or any others.

Our Plastics Division is equipped to produce by any one of the modern fabricating techniques—compression, injection, extrusion, lamination or sheet forming—assuring you of the best possible service at the lowest possible cost.

So, no matter what your product problem may be, come to Continental. You'll find an alert, progressive organization equipped to give sound, practical advice and assistance at all times!



(a) Molding—extruded; (b) Mount for fog horn assembly—compression; (c) Keyboard cover—compression; (d) Military device—compression; (e) Retainer—compression; (f) Sales ticket holder—compression; (g) Funnel—compression; (h) Electrical device part—compression; (i) Sheave—compression; (j) Distributor rotor—compression.

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PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

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COMPRESSION · INJECTION · EXTRUSION
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*To give you the best in plastics service, Continental has acquired Reynolds Molded Plastics of Cambridge Ohio. The facilities of this pioneer organization, combined with Continental's extensive resources, form a Plastics Division capable of designing, engineering and producing the widest range of plastic products for manufacturers and designers.

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● Many postwar ideas now growing into more finished form in engineering and drafting rooms will call for molded plastic parts.

For these, General Industries offers the services of its molded plastics division.

Please get us right. We make no pretense at *designing* your molded plastic parts. You know that job better than we ever hope to.

But, we can tell you whether it's a practical molded plastic job. We can help you select the right plastic compounds—and in many cases can suggest minor changes or refinements resulting in better parts, delivered faster or more economically.

This "know-how" extends through our mold-making and processing divisions. Small parts or large ones are carefully and skillfully engineered through the intricacies of mold-designing, so that when they leave the molds they are accurate in dimensions and finely finished.

Of course, we have the necessary machines for the molding of large or small work, in any quantities, by compression, transfer or injection processes. And we keep our delivery promises.

So, if you are planning postwar products that include molded plastics, keep in touch with General Industries. Right now, we're working 100% for Uncle Sam, but when the end of that is in sight, we'll be glad to work with you.

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Our production, now entirely devoted to war needs, will be converted at the peace to fabrication of many new applications of plexiglas, lucite and other plastics, such as the radio cabinet pictured above.

Come to **dura** with your ideas for postwar plastic fabricating; our experience, personnel and "know-how" are at your service to plan and produce new things efficiently and economically to make this a better world.

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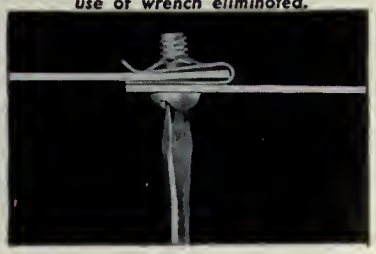
HERE'S THE NUT THAT *Holds itself* IN PLACE!

As "U" nut is slipped over panel, extrusion on lower leg snops into hole—locking nut in screw-receiving position.

With second ponel in ploce, screw is driven into "U" nut. Access to opposite side is unnecessory and use of wrench eliminoted.



Here is a spring steel lock nut that broadens the smile of engineers and assemblymen everywhere. No more fussin' or cussin' over blind location fastening problems. No more expensive welding, riveting, or clinching nut plates in location. For "U" type SPEED NUTS merely snap into holes along the edge of panels, brackets, or flanges.

An extrusion formed in the lower leg of the "U" nut snaps into the screw hole and retains the nut in perfect register until final assembly. By varying the size of the hole, any degree of "float" may be obtained, to compensate for misalignment.

In addition to simple and speedy application, "U" type SPEED NUTS possess exceptional holding power and their arched prongs absorb vibration to definitely prevent loosening. Millions of "U" nuts were used on metal, wood, and plastic products before the war—millions more are being used today on war equipment. And postwar products that will capture the biggest markets will be assembled faster and at lower costs with SPEED NUTS. The men with the assembly "know-how" are the ones who move up the fastest. Write today for literature.

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*Speed Nuts** PATENTED
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FASTEST THING IN FASTENINGS

PLASTICS in PERSPECTIVE.....

EXPERTS in the laundry industry have just issued a warning about resin-treated rayons. The trouble? It's that highly reactive chlorine atom which has played so important a role in the development of organic chemistry generally, and in our own corner of it in particular. Chlorine is a major ingredient in laundry compounds, valued for its bleaching properties, but it reacts with some resins, weakening and discoloring the fabrics with which they have been treated.

Spokesmen for the laundry industry feel that such resins should not be used, and that any troubles arising from their use should be charged to the fabric manufacturers. The latter, however, together with representatives of the chemical industry, point out that not all resin-treated fabrics are affected by chlorine, that laundries could use a comparatively low-priced anti-chlor in their washing compounds when necessary, and that they should learn how to launder the fabrics in question at the most favorable temperature. There is no doubt, they further point out, of the great improvement in properties imparted by the resins to the fabrics. The public, they say, is entitled to these improvements. No one can quibble with that.

Since the October issue of PLASTICS carried an article by Dr. Donald H. Powers of Monsanto on that company's most recent contribution in the field of resin coating and impregnating, Dr. Powers' comment on the controversy is worth quoting here. The Monsanto resin in question, he says, does not retain chlorine. Besides, he adds, why should any fine fabric be subjected to the punishment of a chlorine solution? This commentary is further proof that our development and research organizations must take extreme care to create plastics products which are as foolproof as is possible.

* * *

Like all other materials, plastics have their competitors. But no other material gets around its competitors so often as do plastics materials by marrying into the family, so to speak.

The example of rubber—natural and synthetic—comes to mind. Writing on "The Future of the Rubber Industry" in the Financial World recently, P. W. Litchfield, Goodyear's Chairman of the Board, pointed out among the new outlets for rubber developed during the war were a variety of plastics, adhesives and lacquers. In these circumstances, what is competing with what?

* * *

Talking about ramifications, it is significant that, of the 13 papers presented at the recent conference of the Packaging Institute, no fewer than five dealt with plastics coatings, films and closures.

•

MOST everybody knows that the chemical industries of this country have developed enormously in the last 25 years, so it is difficult to realize that there was not even a school of science in the United States until Harvard established one in 1888. Many of us well remember that virtually all of our professors had to go abroad to study. How, then, have our chemical industries made such great strides in a comparatively short time? Charles A. Higgins, president of the Hercules Powder Company, speaking to a group of technical editors visiting his company's splendid experimental laboratories recently, gave the answer in one word—Research. But research alone is not enough. The company which finances it must also take out of its earnings enough capital to exploit the openings research uncovers, and that means limited dividends stockholder, Mr. Higgins declared. These dividends are supplemented, however, by increased prestige of the company, and that has a value too, even if you can't put an immediate and practical value on it.

There is another thing about research. Although there is an element of chance in it, since you can't always be sure of getting the result you want, it is not the all-or-nothing kind of risk you take in roulette. For one research may suggest another, and if the first proves unprofitable the second may make up for it. We often wonder at the great variety of products put out by a large company. They seem heterogeneous, something of a catch-all, but they are actually the outgrowths of a few basic developments. In the case of Hercules, as Mr. Higgins pointed out, the diverse products all stem from two lines of research.

•

CIVILIAN use of plastics may not develop as fast and as extensively as might be expected in view of the slight go-ahead signal recently given the plastics molding industry, according to the Research Institute of America in a report to its members in business, professional and governmental fields.

The lifting recently of allocation controls over cellulose acetate butyrate, urea and melamine molding powder required in the manufacture of plastics for civilian use was not quite as clear a green light as it might seem. The stocks released were only those not needed by the military services and while the amount is expected to be fairly large, it is not likely to match the huge backlog of civilian demand. More important is the presence of secondary shortages, which have been so prevalent both in chemicals and in processing facilities.

The short supply of injection machines and compression presses, and of the manpower needed to operate them, is limiting production capacity in many localities. A heavy schedule of injection machine production is now under way, but little definite result can be expected before the end of the first quarter of 1945. Phenolic resins and molding compounds are still in tight supply and under complete allocation control with no easing in sight before V-E Day. Plystrene, which injection molders could use as a supplement to the released acetates, is also scarce with small prospects of early improvement. Production in the industry will necessarily be limited until these and other associated chemicals are available in greater quantity for civilian use. Meanwhile, plans should be formulating for intelligent and expansive sales campaigns which would be initiated just as soon as civilian production could be begun. END

Don't be handicapped at the start!

One of these Fellows will Soon Be
In a Bad Spot
When the Flag goes down.
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All he has Under Him is
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Or does he Think Molding is Simple?
A Mold, a Press, a Drum of Gum,
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Thou may not be Happy.

We have a Booklet called
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WHEN YOU NEED . . .

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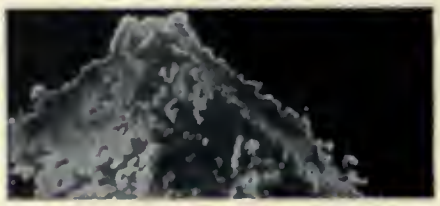
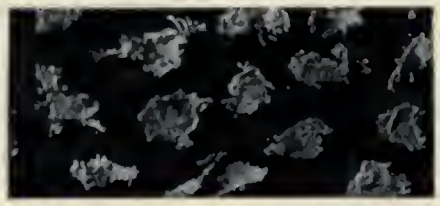


FILFLOC Pure cotton flock of surpassing cleanliness and uniformity.



FABRIFIL Macerated cotton fabric for extra strength.

CORDFIL Evenly cut lengths of tire cord for plastics of utmost strength.

While the application of cotton fillers is still comparatively new, a lot has been learned about them. We have a wealth of information on this subject, representing the findings of molding compound manufacturers and molders, as well as innumerable data resulting from our continuous program of laboratory work.

While we manufacture, as illustrated above, three basic types of fillers for improving the strength characteristics of plastic items, it cannot be too strongly emphasized that there are many varieties of each type of filler. Our objective is to provide for your compound EXACTLY the right filler to contribute the desired combination of tensile, flexural and impact strength your item requires.

Consider us not merely as manufacturers of good fillers, but as Producers of Filler RESULTS.

INVESTIGATE PLASTIC HELMET LINER SCRAP

This is an excellent low-priced molding compound of the phenol formaldehyde type. It can be used on a considerable variety of items—information available upon request.

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Developers and Producers of Cotton Fillers for Plastics

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Through years of experience, the Standard Products Co. has acquired a wealth of knowledge in the art of molding plastics. Standard offers complete molding service.

Standard's molding equipment is capable of producing items of phenolic cellulose-acetate, butyrate, polystyrene, ethocel and other plastic and thermoplastic materials. These facilities assure perfection in the molding job.

The Standard Products Co., with its great resources, can do your job quickly and effectively at moderate cost. Let us have the necessary data and our engineers will submit designs and proposal.

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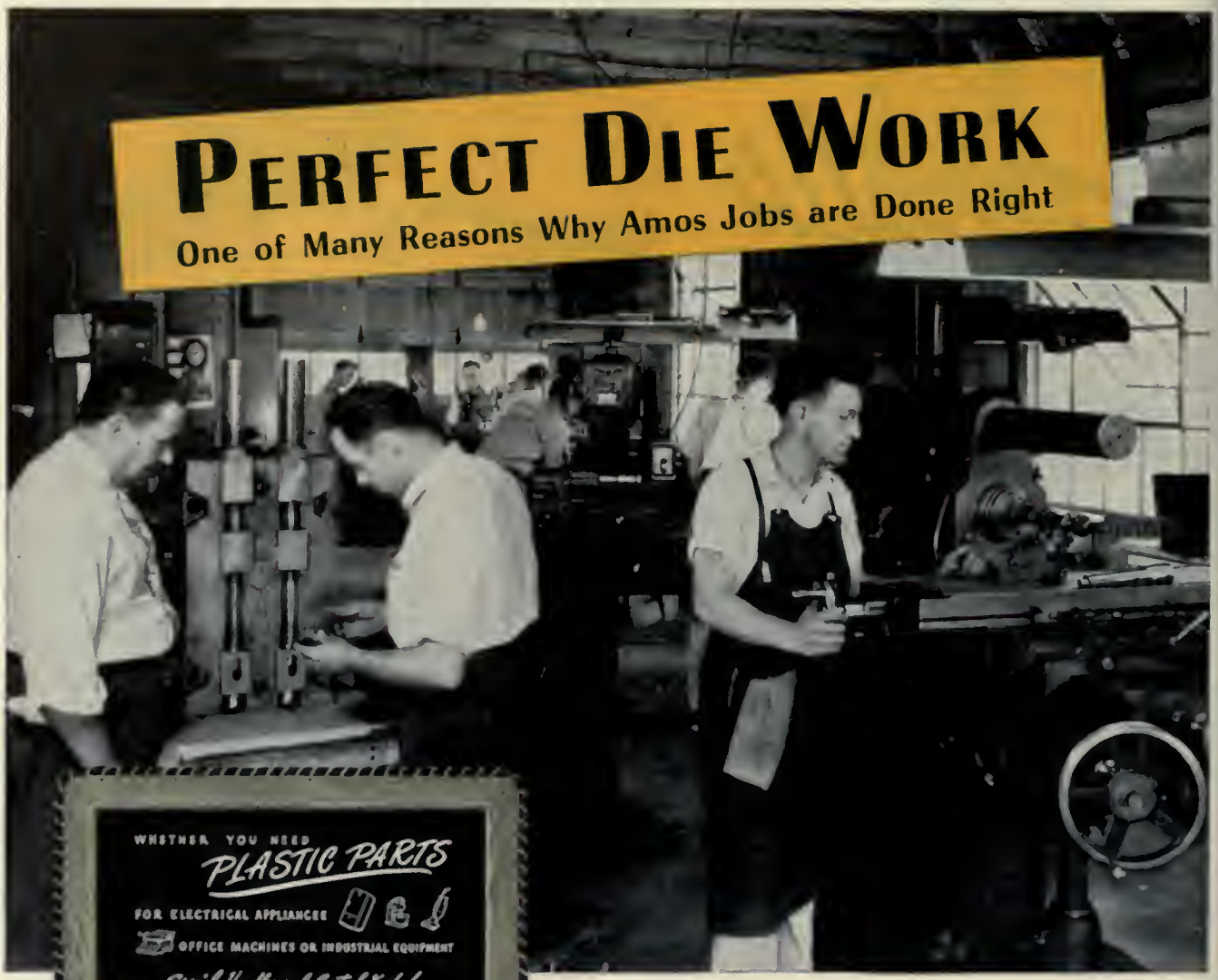

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MOLDED PLASTICS...
Custom Molders of Parts and Products by the Injection Process

To do plastic molding jobs right, one of the many requirements is perfect die work. Above you see one section of the Amos Die Shop in Edinburgh—some of the experienced die makers—and a small part of the equipment used to build and maintain Amos plastic molding dies and fixtures.

Perfect die work is but one of many reasons why Amos jobs are done right. Other reasons include—experienced engineering—the right plastics in the right places—efficient production and accurate finishing, with quality control of every operation.

From engineering to finishing, Amos does a complete job—and does it right. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

"Varied" is the word for applications of phenolics: (1) asbestos-base section of ship's air duct, (2) vacuum cleaner part, (3) textile machinery spool, (4) handbag handle, (5) truck caster, (6) milking cup, (7) distributor head, (8) oil seal, (9) washing machine agitator, and (below) 21" wheel section for "Cardineer" filing system

Phenolics POST-WAR

Preview of Peacetime Applications Indicates Gains For Phenolics as Cast Resins, Laminates and Plywood Bonds

By E. F. Lougee

Chairman, Advisory Board
Plastics Industries Technical Institute

WHEN cast phenolics were introduced to American industry in 1928 they caused considerable stir. They were machinable on simple equipment, and their clear, vivid colors quickly caught the fancy of designers and jewelry manufacturers. Within a short time a whole new branch of plastics manufacturing sprang up with fabricating plants of all kinds and sizes in many cities.

Cast phenolics are especially suitable for costume jewelry because the material is light in weight. Massive though they might be in design, these pieces can be worn without discomfort, and colors may be chosen to complement any costume in the most extensive wardrobe. Cast phenolics are suitable, too, for decorators' accessories, and many practical and beautiful products have come into being where brilliant translucent color is a factor in sales. Chessmen, cigaret holders and boxes, lamps, clock cases, desk and stationery items, buttons, buckles, signs, advertising novelties, bookends, small radio cabinets, handles for table cutlery, and many other things are now commonly made of cast phenolics.

No one foresaw the grim industrial chores cast phenolics were destined to perform in production for war, nor can one safely predict in which field they will find their greatest usefulness in the future.

Parts of oil well shoe guide assembly made of cast phenolic resin by Baker Oil Tools, Inc. Left, mold assembly for guide using brass mold with plastics core. Center, right, two views of plastics shoe guides made in mold. Rear, brass mold top

Phenolic laminates post-formed with low heat, pressure

The first recorded industrial applications of cast phenolics came about when a Pacific Coast oil tool manufacturer, Baker Oil Tool Co., set out to find a material better suited than cement to make the oil well shoe guides which guide casings down into the well. The ball valve, both ball and seat, which control the flow of oil, were molded of phenolic but the shoe was considered too heavy and cumbersome to be produced by this method. Besides, many sizes were needed, and mold costs nearly caused convulsions when they were figured out. Research began with cast phenolics because these could be shaped in simple molds without great expense. Trouble was, cast phenolics alone were brittle, lacked physical strength, cost too much, and had a bad habit of shrinking when cast. In an effort to better the situation, fillers were added to the resins to lower their cost per pound and increase physical strength. A new catalyst was developed which did not embrittle the material. Shrinkage persisted, but that, too, has been gradually overcome. Though this problem is not yet fully conquered, engineers have learned how to control it.

Fine flour, ground from walnut shells, proved to be the most satisfactory filler because it resisted moisture, blended readily and thoroughly with the resin, and is a good binder in its own right. As much as 25 to 30% filler can be added to the resin just before casting, reducing the overall cost about 30%. Clear or pigmented cast phenolics require from 7 to 14 days to cure in drying ovens with carefully controlled temperatures because no catalyst is used. Industrial cast phenolics, however, may be cured in from ½ to 2 hr using a catalyst and an autoclave to speed the process.

With costs brought within reason, oil well shoe guides took cast phenolics thousands of feet beneath the earth's surface into mud-laden fluid to guide a hundred-ton string

Low-pressure molded phenolic air conditioning unit. Right, a section in natural color; left, section with one paint coat

Hinges, low-pressure laminated with phenolic resin-impregnated P-18 cloth. The hinge pin holes are integral parts of the unit

Laminates in which phenolic resins are bonding element are used as silent gears and pinions in factories and on ships

of casing into the open hole of a new oil well. Oil wells are drilled through a succession of such casings or pipes, telescoped one through the other from the surface of the earth to the bottom of the well. Every so often a new string of casing has to be landed and cemented in place. A shoe guide is used on the bottom of each of these strings of casing to guide it to the bottom where it is cemented, and sometimes as many as 2500 sacks of cement are pumped through the shoe in ½ hr. When the cement sets, the shoe is drilled out. Quite a departure from the original use of cast phenolics in the decorative field.

Shoe guide castings weigh anywhere from ½ to 16 lb, and wall thickness is sometimes as much as 4", including internal ribs which are cast as an integral part of the piece. Some of them are more than 1 ft long. Threads are cast into the piece, using a split mold, and surprising accuracy of dimensions is achieved.

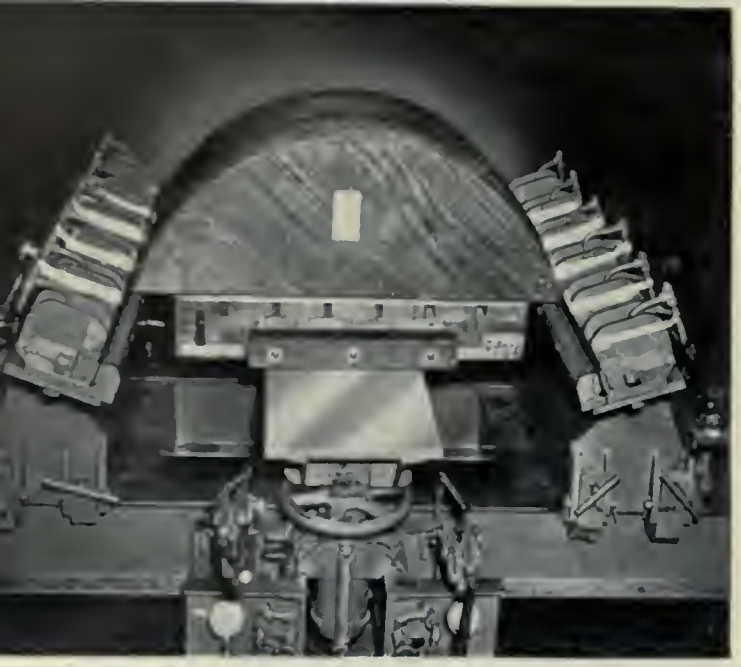
When the scarcity of aluminum began to be felt, cast phenolic match plates were tried. Match plates are used by foundries and serve as a pattern to shape green sand which later is filled with molten metal. The smooth hard surface of the plastics casting gave a perfect impression, and the new match plates worked out well in use. Later, when all metals became scarce, cast phenolics had a real chance to establish themselves as industrial materials, being used mostly in making tools and dies. Here, they have the advantage of rapid casting to any shape; the ability to take a great deal of abuse in use; and there is no limit to the size in which they may be shaped. They require only a simple mold of plaster or the cast resin itself, and no great amount of skill is necessary to do the work.

Cast phenolics soon replaced white metals for jigs, dies and tools in aircraft plants. Forming operations, where aluminum or other metal sheet is pressed into a female die, using rubber blocks or blankets as the male member, were facilitated through the use of cast phenolics. The dies were lighter in weight and could be handled more readily than those made of white metal. They were easier to store because of this, and most dies could be handled by one man alone, saving precious time.

Drop hammer forming, however, proved too tough for cast phenolics to take, so more flexible plastics were used. Aside from this, plenty of jobs remained for cast phenolics and their use extended into other departments of aircraft manufacture. They were used as forming blocks to shape transparent parts such as bomber noses, blisters and turrets. When plywood trainers went into production, cast phenolics dies were used to lay up the laminating strips.

They have competition in this field, however, because dies can be made of plywood or plaster and unless the permanence of the die merits the higher cost and greater weight in very large dies, the other materials are likely to be chosen. This should not be taken as a criticism of the material, nor an example of weakness; it merely accents the fact that plastics of all kinds should be specified and used only where their physical properties give them an advantage over other materials, either in weight, satisfactory performance or cost.

There are those who believe cast phenolics will become increasingly useful in metal forming operations; in automobile plants, or wherever light metals are pressed into shape against a rigid form. And there is no doubt whatever that they will return to decorative applications, reinforced by their experiences and improvements of recent years while they have been unavailable in this field. New methods of casting, new catalysts, quicker curing, improved formu-



Cowling die approximately 4' across, 2' thick produced in less than 24 hr from resin pouring time to time it is ready for use in stretch press. Resin bonds core material added to strengthen die. About 200 lb of Durez phenolic casting resin used to form 2" thick shell over core. Produced by Fairchild Aircraft

Phenolics' impact strength permits use in vacuum cleaner parts

las, and the introduction of fillers have broadened their scope tremendously. If imaginative engineering is intelligently applied to cast phenolics, we shall find them well employed in both art and industry in the days to come.

Fabricating Problems

Fabrication—a branch of the plastics industry which operates with comparatively inexpensive and simple equipment and tools in comparison with costly, heavy-duty presses, pressures and heat—has emerged from the humble station to which it was born. It has passed through the gadget stage and achieved dignity through rapidly growing contributions to industry where its greatest expansion is expected postwar.

Fabricators turned readily from trinkets to munitions. They put aside their bookends to build boats. From cigaret boxes, they turned to ammunition boxes, chutes, hoppers, and other instruments of war. Metal fabricators became plastics fabricators and learned many new tricks. Furniture manufacturers used plastics, many of them for the first time. They found new plastics cements that will change their furniture making routine. They became acquainted with the improved properties plastics have given wood, paper, fabric and glass. They learned new ways to do old things and many of these new ways can be traced directly to phenolic plastics in one form or another.

When aircraft engineers discovered that laminated phenolic sheet could be postformed, they startled the plastics industry into improving its products to facilitate and encourage postforming. As the result, both weight and costs have been reduced in aircraft and a new process is inherited by peacetime industry which is bound to extend into many products formerly made of other materials. Some say refrigerators, sinks, bathtubs, washing machines, and all sorts of household equipment may be made of postformed laminates or by other methods of low-pressure forming. Others say, "Impossible!"

A group of engineers recently discussed the possibility of making refrigerators of plastics materials. Various methods came up for consideration. The insulating properties of plastics were pitted against the noted lack of this property in metal; while others argued that metal was cheaper and easier to form. It was explained that an outside and inside shell of plastics laminates could be molded by low-pressure methods and filled with phenolic foam to give perfect, lasting insulation, resistance to moisture and resulting corrosion and rust, and that the refrigerator could be enameled without the danger of chipping and denting in use. It was estimated that it would be considerably lighter in weight with resulting savings in shipping costs to the manufacturer and greater convenience and savings to home owners who have to move them from time to time as residence is changed. It was pointed out that plastics, being non-resonant, would contribute to the quiet operation of an electric device and motor noise would be barely audible.

A good many obvious advantages were brought to light but one chap with a sharp pencil finally said: "That's all very fine, but your plastics refrigerator will cost from 50 to 80% more than our present metal cabinets and I doubt that the public will appreciate these 'hidden' advantages enough to pay the difference."

What he didn't know apparently is that aircraft engineers and cost specialists felt the same way about plastics until they figured out that savings of approximately 30% in cost and, even more important in aircraft, nearly 40% in weight, have resulted in parts where plastics have been substituted for metals. The greatest cost savings have been made in labor due to the lesser number of operations requiring skill and hand operations in forming plastics materials. And these savings have resulted in spite of the fact that plastics cost considerably more per pound than the materials they replaced. The performance has been equal or better without exception.

Low-pressure molding and laminating will change the complexion of many commodities when their advantages are fully realized and their methods are better understood. While some argue against such radical transition, others will do the very things they say "can't be done."

Many small boats, from dinghies to PT chasers, are laminated this way, using everything from Osnaburg to glass, canvas to wood, as filler. A new lifeboat now in design looks more like a baby's bassinet than a boat but it is rugged and tough. It isn't launched in an

(*Continued on page* 103)

In washrooms on warships

Tenite tumbler holders and soap dishes molded by E. B. Kingman Company. Mirror frames extruded by National Plastic Products Company.

MANY new vessels of the world's largest navy are equipped with mirror frames, soap dishes, and tumbler holders of ivory Tenite. These washroom fixtures have the advantage over metal ones of being non-tarnishing and easy to keep clean.

Tenite has good dimensional stability and excellent molding properties. Tumbler holders and soap dishes are produced by the rapid injection-molding process in single cavity dies, with cycles ranging from twenty seconds for a tumbler holder to forty seconds for a large soap dish. Mirror frames are made of continuously extruded strips of Tenite cemented together in a bond as permanent as the material itself.

Tenite may be made in any color to harmonize with individual color schemes, and it will be a postwar material for bathroom fixtures—such as faucet handles, shower nozzles, soap dispensers, drain stoppers, shower curtain hooks. For information about Tenite and its adaptability to your peacetime products, write to

TENNESSEE EASTMAN CORPORATION
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KINGSPORT, TENNESSEE

TENITE

AN EASTMAN PLASTIC

The Behavior of Thermosetting Plastics at Elevated Temperatures

By John Delmonte and E. Watkins

Technical Director — Instructor in Plastics
Plastics Industries Technical Institute

Full-Cured Phenolic Laminates Can Be Formed Under Extreme Heat

ALTHOUGH phenolics have always been regarded by the plastics industry as thermosetting and infusible, recent tests have proven that at high temperatures fully-cured, laminated phenolic sheets can be formed and drawn. In this process, which gives promise of extending the field of application for phenolic laminates considerably, commercial sheets of grade C material are subjected to the elevated temperatures for a few minutes, then are placed in forming jigs and shaped much like thermoplastic sheet stock. Numerous aircraft parts and equipment are now being fabricated from the formed material.[5] Inasmuch as fully-cured stocks have been formed, the definition of a thermosetting material seems to require revision.

In the current investigation, a method was sought for evaluating the thermoplastic properties of fully cured thermosetting laminates at elevated temperatures (above 300° F), inasmuch as no data of this nature have been reported in plastics literature. By this technique it is hoped that means will be made available for evaluating various grades

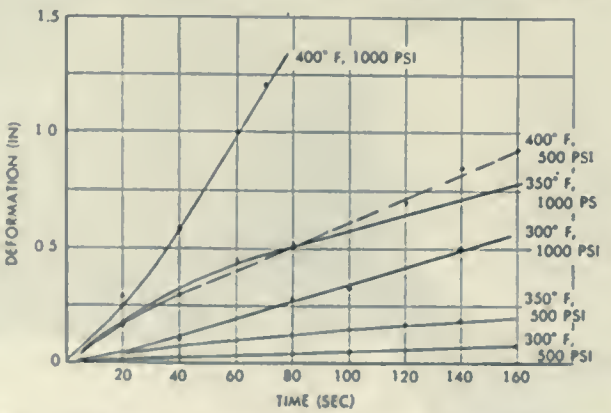


Fig. 1. Deformation of standard ⅛" Grade C phenolic laminate

of thermosetting laminates with respect to their formability at high temperatures. Canvas-base laminated phenolics have been chosen both because they have higher impact strength than the paper grades and because they blister less at elevated temperatures and atmospheric pressure.

The fact that properties such as creep rates may increase tenfold in going from 75 to 200° F [1] and that flexural strength, tensile strength, compressive strength, etc., decrease at elevated temperatures [2] is indicative of the "softening" of thermosetting materials. In fact, a loss of approximately 30% flexural strength in going from room temperature to 300° F has been reported [2]. Of course, as a group, thermosetting materials are less sensitive to temperature changes than are thermoplastics.

The test method employed in this examination was a

Based on a paper delivered by the authors before the 1944 annual meeting of the ASTM, New York.

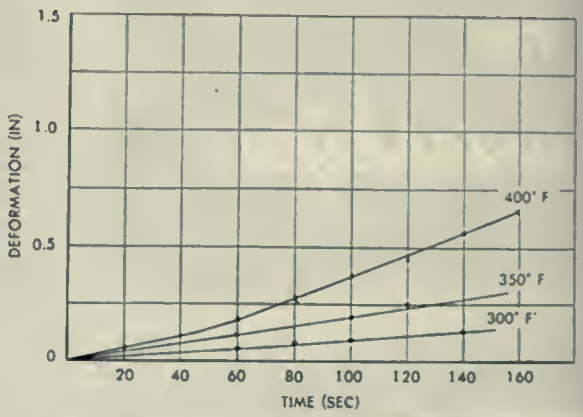


Fig. 2. Influence of temperature on phenolic laminate ¼" thick, cured for 30 min at 330° F, 1500 psi, 49% resin, 8-oz Osnaburg. Maximum fibre stress—1000 psi

modified form of the ASTM Tentative Method of Test for Distortion Under Heat of Molded Electrical Insulating Materials (D 648-41T).[3] A recorder and follower rod mark the deflection at the center of the test specimen. Instead of heating the plastics material at a slow controlled rate as required for the ASTM heat distortion point determination, an oil bath already heated to a predetermined temperature was employed. Several variables of applying load and temperatures were explored, including the times of immersion in the hot oil before applying load. However, in the method finally adopted, the test specimen was loaded for about 10 sec in the open and then covered with hot oil. The calculated load was applied for 10 sec after introducing the oil. The deformation at the center of the specimen was recorded automatically as a function of time. This exact procedure was followed throughout all tests, since preliminary tests showed that accuracy would be affected if these precautions were not taken. For example, if the test specimen is immersed in the hot oil too long before the load is applied, further cure of the material may interfere with its high-temperature flow properties. It was realized, of course, that the high temperature would bring about further polymerization, though the test was designed to demonstrate the im-

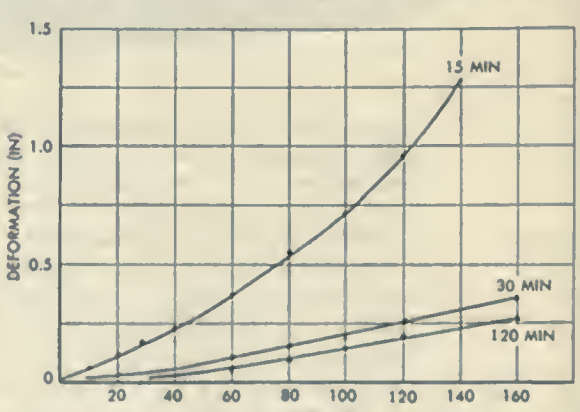
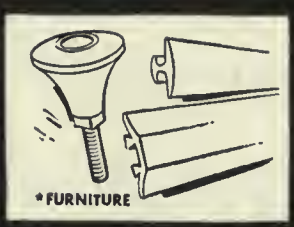


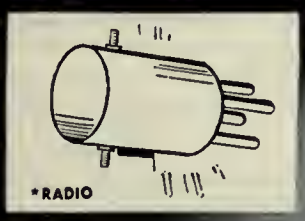
Fig. 3. Influence of time of cure on the deformation of laminated phenolic ¼" thick, which has been cured at 330° F, 1500 psi, 49% resin. Oil temperature, 350° F

*COSMETIC

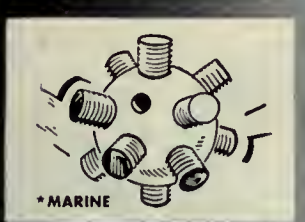
*AVIATION

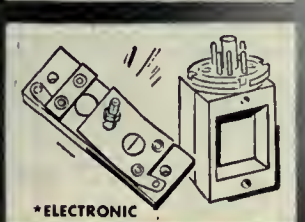
*CLOTHING


*FURNITURE


*RADIO

*AUTOMOTIVE


*MARINE


*ELECTRONIC

*LIQUOR

*NOVELTY

*DRUG

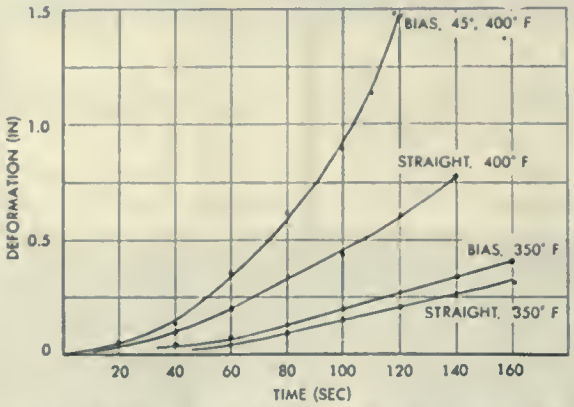


Fig. 4. Influence of cloth weave on deformation of Grade C phenolic laminate ¼" thick; maximum fibre stress, 1000 psi

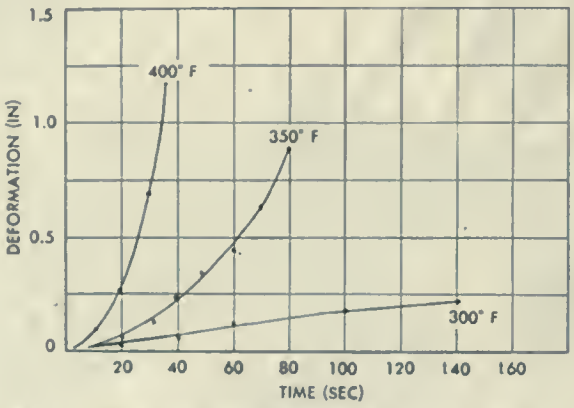


Fig. 5. Deformation characteristics of "Micarta 444" having thickness of 0.110", maximum fibre stress of 1000 psi

mediate softening or plasticizing effect of high temperatures on thermosetting compounds.

The tests were conducted upon specimens measuring approximately 5" long by ½" wide, and ⅛ and ¼" thick. They were mounted upon the standard 4" span for flexural and heat distortion tests. Constant loads were applied by means of a rod and member with ¼" diameter at the end. This load was maintained in position throughout the entire test. The rod and chain recording system employed in ASTM Method of Test for Measuring Flow Temperatures of Thermoplastic Molding Materials (D 569-43)[4] were adapted to the requirements of this test. In calculating weights to be added to the center of the span, the weight of the follower rod was taken into consideration. The maximum deformation capable of being measured by this test arrangement was 1½". Temperatures were held within

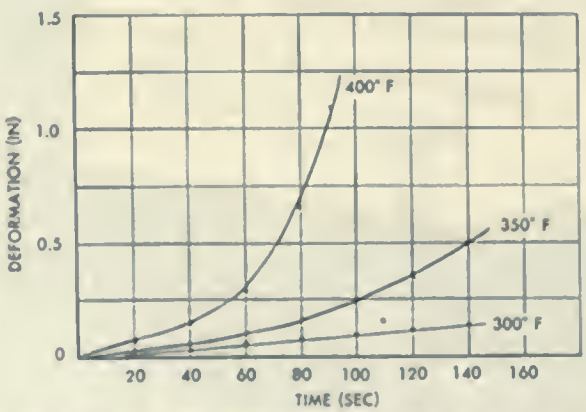


Fig. 6. Deformation characteristics of "Micarta 444" having thickness of 0.227", maximum fibre stress of 1000 psi

± 5° F and recorded on individual curves showing deformation vs time under stress. An electrical immersion heater placed in the container maintained the oil at a constant temperature during test. While temperatures in excess of 400° F are commonly employed in forming and drawing thermosetting laminates, the maximum temperature investigated was 400° F, because above this range blisters may form and interfere with accuracy of the deflection readings.

In effect this test method is a measure of flexural deformation of thermosetting materials at temperatures of 300 to 400° F at maximum fibre stresses of 500 to 1000 psi. The radical change in deformation rates was quite noticeable for some of the materials tested when making comparisons between data for 300 and 400° F. In general, it may be considered that a fast deformation rate under constant stress is indicative of good formability. Tests were conducted to determine the instantaneous elastic deformation of thoroughly heated thermosetting laminates. At 375° F. this deformation proved to be approximately 40% of total deformation after 2 min.

Materials Tested

Inasmuch as this particular test method was designed for the evaluation of formability of thermosetting laminates at elevated temperature, the tests were confined to thermosetting laminates. Dry and 50% relative humidity preconditioning was applied to a selected group of laminates with no observable effect on the results. Various variables within the laminates themselves were explored including: (1) effect of curing time, (2) effect of specimen size, and (3) influence of cloth reinforcement. In addition, several commercial grades of heat-forming, thermosetting laminates were selected and compared under standard test conditions established by this paper. Samples included *Micarta 444*, and *Formica CN-11* laminated phenolic. In addition, the formability of cured molded phenolics was demonstrated by testing a wood-flour filled molded phenolic.

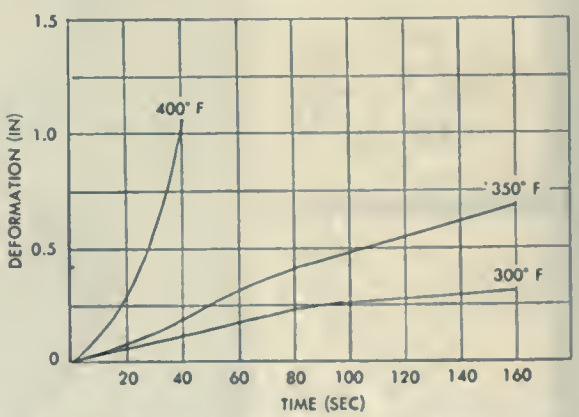


Fig. 7. Deformation characteristics of "Formica CN-11" having 0.120" thickness, maximum fibre stress, 1000 psi

Stress Calculations

When the load is applied at the center of a beam, the maximum fibre stress is calculated from the well-known formula for rectangular beams:

$$\text{Stress} = \frac{3 \times P \times l}{2bd^2}$$

where:

P = load (lb)
l = span length (")
b = width (")
d = thickness (").

(*Continued on page* 100)

Dainty

curtain materials for a lady's shower

Tough

upholstery and paulins for army trucks

It doesn't make much difference what type of fabric or the degree of protection needed—*our equipment can coat it.*

If your post-war plans call for plastic coated fabrics or papers, we suggest that you investigate our facilities.

Here is a plant with—

— several million dollars in fabric coating equipment specially designed for the application of vinyl resins, pyroxylin and other plastic compounds.

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— hundreds of intricate formulas covering many types and degrees of fabric protection, developed by our own chemists.

You tell us what is expected of the plastic coated fabric called for in your plans—where and how it will be used—against what must it be protected. We will help you select the fabric construction and formulate the correct plastic coating to meet your requirements.

Today we are turning out millions of yards of plastic coated fabrics and papers that are being subjected to grueling punishment in every part of the world. Samples of these materials are available for your inspection on request.

See us soon, for once our facilities are no longer required in the production of coated fabrics for the armed forces they will be at your service.

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Paper Base Laminates For Aircraft

By L. H. Ritter
Service Engineer, Plastics Division
McDonnell Aircraft Corp.

Fig. 1. "Structomold" gunner's seat saves 43% in weight over magnesium

High-Strength Phenolic Now Used in Aircraft Has Extensive Future In Complex Structures

AFTER more than 4 years of research and development work, the plastics division of McDonnell Aircraft Corp. has produced what it considers an approach to a satisfactory structural plastics. Termed *Structomold,* this plastics is a high-strength, phenolic paper-base laminate, on which an ultimate tensile strength of 45,000 psi has been obtained on parallel-laminated laboratory samples.

This represents a general increase of nearly 300% over the average laminated fabric or paper-base phenolics. All the parts and assemblies pictured herein were produced by the company's plastics division.

It will be observed from the photographs that McDonnell Aircraft has specialized in molding, fabricating and assembling large and complex parts and assemblies for which it has developed its own techniques. Molding is done at low pressures on metal dies, which results in parts with excellent finishes. Color and designs are incorporated in the molding operation by using printed paper and colored paper or resin.

Fig. 2. Bottom view of gunner's seat shows 5 separate moldings, which include compound curvatures requiring use of build-ups

Characteristics

The mechanical and electrical properties of *Structomold* shown in the accompanying tables, represent findings obtained several months ago and may be used as design values since they are considered conservative, based on the improvements made since that time. The mechanical properties of this material in particular have shown considerable advance in the last 18 months, and will doubtless continue to do so as the research and experimental work progresses.

An outstanding example of the replacement of metal by plastics is that of a stainless steel ammunition box, which is now made of *Structomold.* The use of this new box results in a weight saving of about 40%. In addition to this advantage, the plastics box is more rigid due to the thicker gage of the material used, thus improving operation of the unit by eliminating jamming. The method of assembling this box is by the McDonnell method of hot-bonding, in which very few rivets are used. Approximately 10,000 boxes of this kind have been produced for an Army combat airplane.

Compound Curvatures

Figs. 1 and 2 show top and botton views of a gunner's seat, which consists of five separate moldings and represent some of the most difficult molded laminates produced to date. The top of the seat and the stiffener on the bottom are compound curvatures which require the use of tailored build-ups. The stiffener is locally reinforced by tapering the thickness of the part from 0.1 to 0.2".

The base of the seat is made in three sections for ease of molding, and each section is a channel with a curved web. The lower flange is 90° to the web of the channel and contains several joggles. The upper flange is a varying angle to match the contour of the top.

Properties of "Structomold"

Mechanical	"A" 100-0 Parallel-Laminated	"A" 50-50 Cross-Laminated
Specific Gravity	1.35-1.40	1.35-1.40
Tension		
Ultimate, with grain—psi	35,000	25,000
Ultimate, across grain—psi	18,000	
Modulus of elasticity, with grain	3,000,000	2,300,000
Modulus of elasticity, across grain	1,500,000	
Compression—psi		
Ultimate edgewise with grain	19,000	18,000
Ultimate, edgewise across grain	17,000	
Ultimate, flatwise	40,000	40,000
Flexure		
Modulus of rupture, with grain—psi	32,000	26,000
Modulus of rupture, across grain—psi	20,000	
Modulus of elasticity, with grain	3,000,000	2,000,000
Modulus of elasticity, across grain	1,500,000	
Shear—psi		
Edgewise, across grain	13,500	13,000
Edgewise, with grain	13,000	
Flatwise, across grain	12,500	11,500
Flatwise, with grain	11,000	
Bearing—mean values—psi		
With grain	30,000	30,000
Across grain	30,000	
Hardness, Rockwell	M100	M100
Water Absorption (24 hr total immersion)		
1/8"×1"×3" specimen (unsealed edges)	3-4%	3-4%
1/8"×1"×3" specimen (sealed edges)	1-2%	1-2%

Electrical	Power Factor	Dielectric Constant	Loss Factor
Dielectric losses at 25° C			
60 cycles per sec.	0.0313	7.00	0.219
10^3 cycles per sec.	0.0176	6.80	0.120
10^6 cycles per sec.	0.0425	6.15	0.261
Volume resistance			
DC resistivity at 30° C	Megohm cms. 4.32×10^6		

	Volts per mil
Dielectric strength at 25° C	
Short time, thickness 125 mils	700
Step by step, thickness 125 mils	543
Specific gravity	1.38
Water absorption (24 hr total immersion)	
1/8" × 1" × 3" specimen (unsealed edges)	3-4%
1/8" × 1" × 3" specimen (sealed edges)	1-2%

Note: Material is not affected by oil or high octane gasoline, mild acids or alkalis.

Fig. 4. Gun turret floor assembly with ammunition guard

A weight saving of approximately 43% was achieved by the use of *Structomold* in place of the original magnesium.

Figure 3 illustrates the canopy door for the gun turret. A vinylite plastic extrusion was used for the sealer on this door assembly.

A gun shield was produced of *Structomold* with a weight saving of approximately 45% over the metal part it replaced. The curved channel sections of the shield have 90° flanges and are riveted to the side panel. A number of metal fittings were used in this assembly.

Complete Floor Assembly

Another unit with which considerable success was experienced was a complete floor assembly (Fig. 4) incorporating an ammunition guard. The bottom molding is 0.18" thick and is almost 50% lighter than the original metal part. Beads were employed to increase the rigidity, and the center is flanged to accommodate the ammunition guard which consists of two separate moldings. The side panels are post-formed from high grade phenolic fabric flat laminates to produce the desired shape. The metal hat section fittings and rim around the top of the panels were made from aluminum and are assembled to the plastic by means of rivets and screws.

Navy Projects

The Plastics Division of McDonnell Aircraft is producing experimental wing tips, complete wing panels, droppable fuel tanks, helicopter rotor blades and radar and radio equipment housings for the Navy. All of these items, with the exception of the wing tip, are either confidential

Fig. 3. "Structomold" canopy door for the nose turret on a Consolidated "Liberator", with vinylite extrusion for sealer

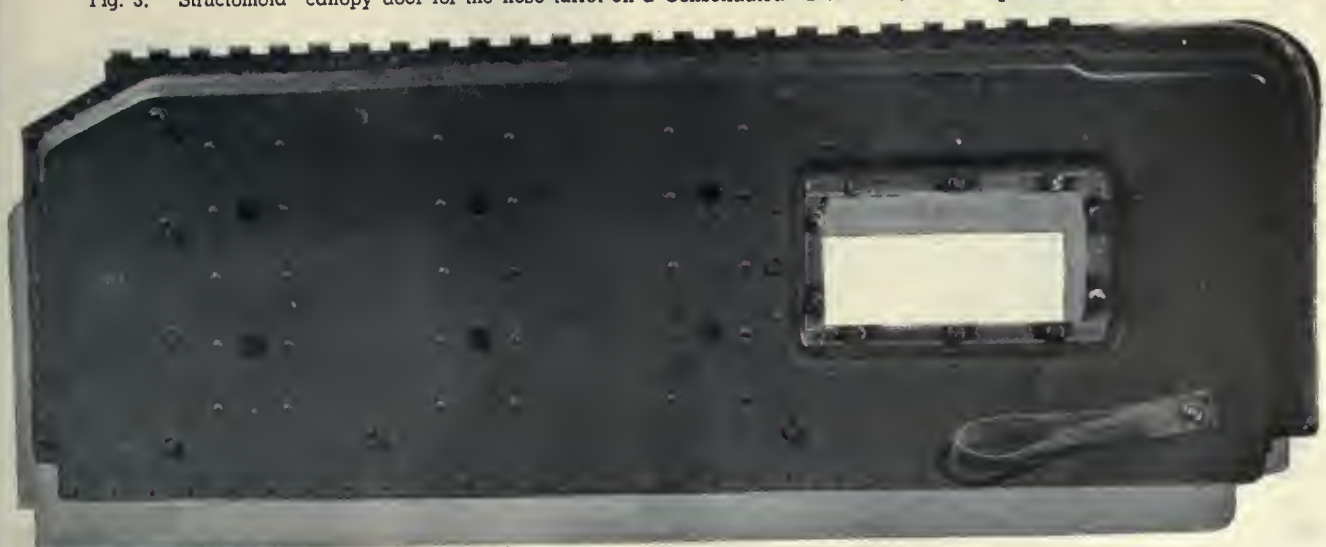


Fig. 5. First step in producing turret floor support shown in Fig. 4 is loading blanked paper into the molding press

Fig. 6. The finished turret floor support is removed from the press after the molding operation has been completed

or restricted projects. Although the plastic tip weighed as much as the metal tip, the plastics assembly consisted of only 13 parts as compared to 96 parts required in the aluminum wing tip.

The complete wing panels will be static tested before the end of this year and then additional panels will be constructed for flight tests. Since the panels are to be assembled in an all metal bomber, in place of the metal wing panels, the plastics panels had to be designed and constructed to take the same stress loads. Also the hinge fittings for attachment to the center section, cut-outs for wheel wells, fuel tanks, landing lights, etc., had to be the same as those in the metal panels. Of course, this requirement does not permit the best plastics design. If the entire airplane were designed for plastics construction, the design of these outer wing panels would be quite different. However, a considerable amount of knowledge will be gained through this project and the answers to numerous questions concerning the feasibility of using plastics for structural purposes in aircraft will be obtained. No plywood is used in this wing panel.

"Structomold" Laboratory Test Results

	"A" 100-0 (Parallel Lam.)	"A" 50-50 (Cross Lam.)
Tension		
Ultimate, with grain (psi)	43,000	29,000
Ultimate, across grain (psi)	20,000	
Modulus of elasticity, with grain	3,800,000	2,700,000
Modulus of elasticity, across grain	1,700,000	
Compression		
Ultimate, edgewise with grain (psi)	22,000	22,000
Ultimate, edgewise across grain (psi)	22,000	

Paper, fabric and fiberglas are all used as reinforcing materials with phenolic low pressure (250 psi) and contact pressure resins in our droppable fuel tank. This auxiliary tank, which has a capacity of approximately 150 gal, is designed for use with a specific airplane. It will differ from other tanks in that it will fair into the fuselage and, therefore, be superior aerodynamically.

One-Piece Box Molds

All that can be said now regarding our plastics housings is that one-piece, box-shaped moldings roughly 7" deep by 15" by 20" have been produced. The material used is our high strength paper and the moldings were made with metal male and female dies. Boxes of almost any size can be molded in this manner. As far as we know, our process of molding a one-piece box from laminated plastics has never been done before. Boxes or housings molded in this manner are more attractive, stronger, lighter in weight, waterproof, and cost less than when fabricated.

In contrast to the actual working data presented on *Structomold* in the first table shown in this article are data obtained with laboratory tests, as set forth in the table above. The latter cannot, of course, be used for design purposes.

Having carried out a very extensive research and development program, McDonnell is in a position to design and produce plastics laminated materials from high pressure thermosetting, low pressure thermosetting, and contact pressure resins with paper, fabric, *Fiberglas* or special fillers made from natural or synthetic fibers, the resin and filler combination being carefully selected to meet the requirements of each individual design. END

Fig. 7. A 1-piece molding is used for the box in this communications equipment housing for the Navy. The closed view shows the unit before application of paint coat

"I'll tell you what I'd like for Christmas, mister"

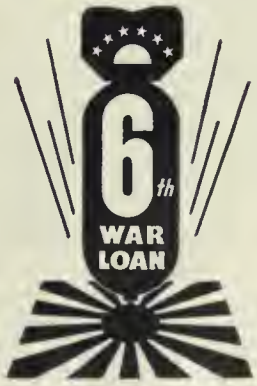
"This sounds like the old days when I used to hint to the folks about the things I wanted — like the electric razor that made me feel so grown-up just to think about!

"But this year — well, what I want comes in an awfully big package. What I want — and all the fellows I'm teamed-up with, too — is to see a few more B-29's around these parts!

"Yes, a B-29 costs a hell of a lot of money. $600,000, they tell me! But you ought to see what one of those babies can do to the plenty-tough guys in front of us! And I'd hate to tell you what it costs *not* to have that kind of help. It costs — well, the way we reckon costs around here is in how many kids won't make the trip back home."

★

Let's forget that a War Bond is the safest investment in the world. Let's forget, even, that the more War Bonds you buy the more you help curb inflation, and build a firmer future for all of us. Let's remember only one thing: this war is far from over; the war in the Pacific is one of tremendous distances — and correspondingly great costs; yet a brutal adversary that is fighting savagely every inch of the way must be defeated. Let's help the boys who have *that* job to do by doing *our* job with War Bonds. Help shorten the war—with an *extra* Bond today.



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Molded of "Tenite II" in attractive colors, these garden tool handles are said to be first of kind; more durable than wood

Another type of tool now boasting plastics handles is that used in woodworking. Light in weight and having uniform hang and balance, the handles are injection-molded of "Tenite"

The Role of Plastics in Hand Tools

By Philip Pollack

Natural Advantages Plus Wartime Improvements Open Broader Field

ALTHOUGH the use of plastics in hand tools is not new, their role in this field has grown in a short span of years from an accessory to a major one, and they have helped the tool, in many instances, to achieve fuller functional realization and greater efficiency than was possible with wood or metal.

Since their torque and impact strength, toughness and durability are greater than that of hardwood, they insure longer wear under conditions of rough treatment. Plastics-handled screwdrivers, for example, which are often substituted for chisels, are pounded with hammers and dropped against hard surfaces. Wooden handles would split, chip and become mashed to the point at which they became unfit for further use.

The dielectric strength of plastics handles protects the mechanic against shocks when he is working with electrical equipment. These materials are also pleasant to the touch, are easier on the palms and fingers when pressure is applied, do not form slivvers and will not rust. Their attractive coloring, as demonstrated by the photos on the opposite page, have the psychological effect of banishing drabness from the job.

The plastics used in mechanics' and carpenters' tools are either cast resins, casein, acetate butyrate, cellulose nitrate, ethyl cellulose or cellulose acetate, the latter two being employed in injection molding in the form of powder. Cellulose nitrate is furnished to the tool manufacturer either as machined handles or as rods, in which case he machines the handles from the rod on a lathe.

Opinion is divided as to the relative merits of these plastics, all of which find specific applications to which they seem best suited. Cellulose nitrate, for example, has a lower moisture absorption than cellulose acetate; is tougher, easier to work, and is capable of being formed

(*Continued on page* 114)

Beauty joins utility in these "Tenite" hand-tool parts: Above, wrench handle molded to metal; below, laundry spray casing; right, durable garden tools

Plastics Tile for Handbags

Highly Colorable and Easily-Cleaned, They Stimulate New Consumer Demand

FOR years, the perishability of materials commonly used in Summer handbags has plagued both the consumer and the merchandiser. Rarely do such bags last for more than a single season—if that long. Even during the season of use, signs of wear rapidly become evident due to the tendency of the materials to soil quickly and permanently.

With the advent of smartly-designed plastics tile handbags, however, the market for this type of accessory has shown new life. Women demand not only white and pastel shades in Summer bags, but also similar bags in Fall and Winter shades and styles.

Illustrated above are one type of plastics tile handbag now available and a group of injection-molded tiles still joined by mold sprue. Made of *Lumarith*, cellulose acetate, the tiles are formed in dies capable of producing 36 at each injection, thus reducing manufacturing costs and permitting volume output of bags.

The colors shown are only a few of those possible with this material, which has great natural affinity for color and lends itself well to color variations. It is also impervious to body acids, and neither its colors nor surface texture are affected by constant handling. More than 200 tiles, laced together by hand, form the finished bag.

Lumarith is a product of Cellanese Celluloid Corporation of America, New York, N. Y. The tiles are produced by Sterling Injection Molding Co., Buffalo, and Consolidated Molded Products Corp., Scranton, Pa. END

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Not just plastics, not just metals, but both — and combinations of both—are the raw materials with which the Bay Manufacturing Division of Auto-Lite works to achieve true functional beauty. Beauty which works, as created by Auto-Lite under one big roof, will be one of the major forces in selling in tomorrow's competitive market. Postwar designers are invited to inquire into the advantages offered to them by Auto-Lite's artisanship in plastics and metals.

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HOOSIER CARDINAL CORPORATION

Molding Permanency In Heel Coatings

Plastics, Injection-Molded over Wood Heel Cores, Form Durable, Seam-Free Finish of Even Thickness

ONE of the chief concerns of women in selecting dress shoes has always been the durability and appearance of the heel, since this portion of the shoe is very much exposed and subject to considerable wear.

Thanks to a new process it may soon be possible for women to have heels coated with plastics materials that not only outlast the shoe itself, but also offer a wide choice of finish, color and style.

Through this process, the wooden heel core of any type of shoe can be covered with a thermoplastics coating approximately 1/16″ thick, evenly distributed by injection molding. The material is spread around the core under pressure so that it slightly impregnates the wood, thus forming a seam-frec, permancnt bond. This coating is said not to wear or peel off, and is not affected by dirt, mud, ice or snow, all of which can be washed off.

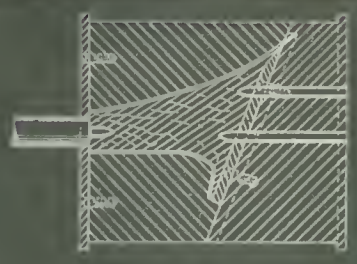
Dull or shiny finishcs are available in an almost unlimited range of colors or combination of colors, in imitation alligator, snakeskin, patent leather or any metallic hues desired. Since the coating is not molded over the top or bottom of the heel, the wooden core may be attached to shoes and the leather lift to the heel in the usual manner. The new heels will be compctitive in price with widely-used celluloid covered heels and far below the price of leather-covered heels.

Hitherto, methods used in molding or casting a plastics material around a wooden core often produced unsatisfactory results, since the pressure utilized in injection molding would shift the core on its supporting pins, thus deforming it and resulting in an uneven coating.

The new proccss involves a novel molding apparatus for this work in which the coating is cast about a supported wooden core under high pressure by indirect feeding,

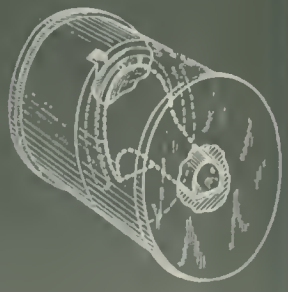
(*Continued on page* 117)

Three views of improved mold



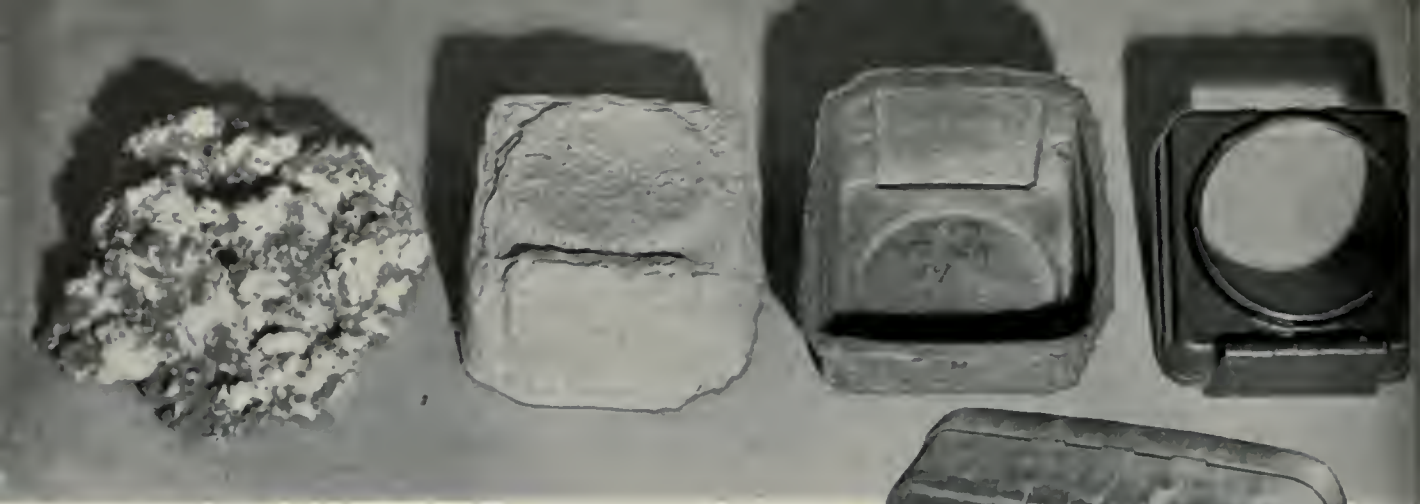
View through mold showing how wood core is supported

Large end of finished heel; note sprue still attached



Mold view revealing how core

Wide range of colors, finishes are obtainable with new method



Four stages in the forming of a clock case from resin and paper pulp: Left to right, raw pulp, rough preform, impregnated preform, compression-molded case

Resin Fibre Preforming Aids Product Design

By N. J. Taylor

The completed timepiece, designated "Waralarm", with mechanism installed

Simplifies Making of Plastics Products Having Large Surfaces, Complex Contours

MANY production design problems which only a short time ago were real headaches to plastics designers and manufacturers are being handled to-day with surprising ease, as a result of the discovery not only of new materials, but also new processes for handling old materials.

Among the most promising of these are the new developments in the preforming and molding of various resin-impregnated, fibrous materials. The present resin-fibre technique is a new process only in that it combines the arts of two older industries: Fibre pulp molding and synthetic resin production.

A relatively short time ago production of plastics pieces involving large surface areas with deep-drawn or complex contours were usually sidestepped by the plastics field or shunted on to some other industry, particularly if there were requirements calling for high mechanical strength.

To-day the alert designer, in utilizing the resin-fibre molding process, finds these production problems almost as simplified as though the design called for flat sheet surfaces. By this method of production of comparatively large articles of considerable contour and uniform section thickness, such as refrigerator panels, aircraft fairings, radio cabinets and trays, the experimental stage has been satisfactorily passed, and they are either already in production or are ready for production when priorities will permit.

In the procedure ordinarily followed in the manufacture of a resin-fibre preform, the slurry or raw material is mixed in a beater of the design commonly used in the paper industry. This fibrous pulpy material is then vacuum-felted or suctioned to the surface of a screen accurately shaped to the form of the finished article. To insure this accuracy the finishing mold and the screen are usually designed at the same time. This is necessary, since there will be but very little flow with this type of fibrous material in the final molding operation as compared with regular molding materials. Free liquids are then removed and the preform thoroughly dried, producing a light, porous item, rougher and much thicker than the finished piece will be. At this point the thermosetting plastics resins can be impregnated into the preform, if it has not been incorporated into the slurry in the beater before the felting operation. In either event the preform is now subjected to heat and pressure, usually by the ordinary compression molding method.

Where a high polish is required on the finished article, the conventional polished steel molds are used. However, where a high polish is only necessary on the outside, the female die is made of polished steel and the male die is made of the expanding rubber type material which enables the molder to apply the required pressure to the inner surface of articles with a deep draw and also permits considerable savings in die costs. The result is a product of hard, high density, great impact resistance and possessing many other desirable mechanical properties.

One of the principal reasons that these characteristics result from this process is that when the pressure and heat are applied in the final molding operation, there is no disturbance or dislocation of the fibre filler from its original

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Large, 16½"-diameter world globe above was deep-drawn from resin-impregnated paper pulp. It rests free in wood support. Below are the halves from which the globe was fabricated

position in the mold. Neither the size nor shape of the finished article is affected by the limitations of the flow of either the filler or the resins as is the case in compression and injection molding. These two components are in their final locations before the heat and pressure are applied. *This means that lower pressure can be used without necessitating high tonnage presses, with their accompanying higher costs. It also means that there is no stress or strain produced around corners or curves during the molding operation with their resulting weakness at these points in the finished article, as is often the case with laminating.*

While the pulp forming process lends itself to the fabrication of large pieces of structural requirements, it is also being utilized to a great extent in successfully handling complicated contours in smaller items.

A striking development in small-article production is the precision tolerance maintained in the manufacture of such items as diaphragms for loud speakers, radio and other forms of communication systems. Maximum molded thickness is 0.003" and the minimum 0.002". The tolerance allowed is 0.0002".

So successful has been the resin-fibre method in producing these diaphragms to the minute specifications demanded, that an entire plant is now required for this item alone. This plant, operated by the Hawley Products Co., St. Charles, Ill., manufactures over 80% of the diaphragms produced in the United States. The total number of these items produced since the war began runs well into the millions.

In the perfection of a sphere for a world atlas, the molded fibre process ended a production problem that has been a challenge to plastics molders for some time. This item called for a perfect drawn surface that would meet the precision of continuance necessary for the perfect alignment of the surface figures of the completed map. In addition light weight and high impact resistance were produced at a comparatively low cost.

Due to the almost 100% war uses for resin-fibre preforming, color and appearance have been secondary considerations up to the present time. Lately, various hues have been obtained by incorporating dyes in the basic materials

(*Continued on page* 108)

TABLE 2—Effect of Fiber Type on the Physical Properties of Fiber-Resin Preformed Material

Preformed Fiber Resin	Resin Type and Content	Mold. Press. (psi)	Spec. Grav.	Flexural Strength (psi) Parallel (#) Flex. (psi)	Parallel (#) Defl. (in)	Perpendicular Flex. (psi)	Perpendicular Defl. (in)	Edgewise Compress. Strength (psi)	Impact Strength (Notch. Izod—Ft/lb/in/notch) Perp.	Para. (x)	Tens. Str. (psi)	Water Absorp. (%)
Kraft (unbleach)	45% Resinox 635	2200	1.33	17,140 ±1008	0.081	17,120 ±676	0.077	27,400 ±333	3.11 ±0.10	0.85 ±0.05	11,400 ±740	0.58
Alpha	45% Resinox 635	2200	1.35	17,100 ±700	0.071	19,300 ±775	0.088	25,540 ±804	1.91 ±0.09	0.85 ±0.03	11,260 ±1243	0.43
Defibered Rag	45% Resinox 635	2200	1.35	17,000 ±775	0.097	16,200 ±533	0.093	26,400 ±1200	2.67 ±0.15	1.54 ±0.04	10,000 ±320	0.66
Sulphite (unbleach)	45% Resinox 635	2200	1.35	15,930 ±252	0.067	15,260 ±328	0.060	26,500 ±1300	2.69 ±0.32	0.78 ±0.04	9500 ±480	0.61
Ground Wood	45% Resinox 635	2200	1.34	11,800 ±220	0.055	10,820 ±234	0.059	22,400 ±1243	1.21 ±0.07	0.55 ±0.04	8400 ±809	0.43
Waste Paper	45% Resinox 635	2200	1.35	11,600 ±1732	0.044	12,320 ±864	0.046	28,000 ±943	1.54 ±0.09	0.61 ±0.21	8100 ±807	0.51
Asbestos Glass Fiber 85-15	45% Resinox 635	2200	1.72	17,700 ±525	0.050	17,970 ±1155	0.050	27,000 ±640	2.94 ±0.19	2.10 ±0.05	9300 ±1400	0.14

(#)—Broken parallel to molding pressure
(x)—Notch runs parallel to molding pressure

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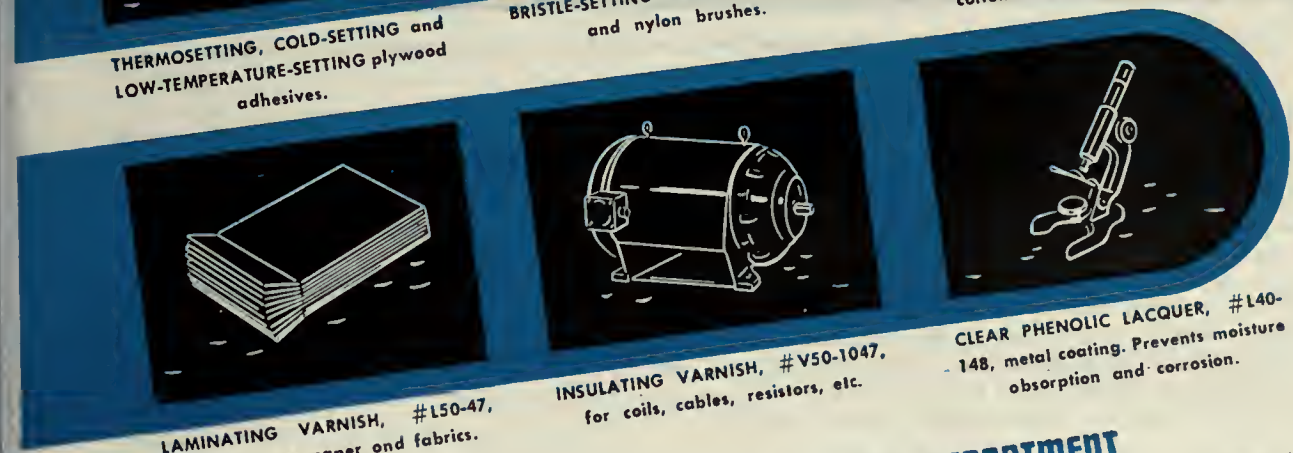
BRISTLE-SETTING CEMENT for hair and nylon brushes.

LOW PRESSURE LAMINATING RESIN, #1389, for fiberglas cloth, poper cotton cloth and plywood.



LAMINATING VARNISH, #L50-47, impregnating paper and fabrics.

INSULATING VARNISH, #V50-1047, for coils, cables, resistors, etc.

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Machining PLYWOOD

High speed routing operation on plywood panel with bit r otating at 24,000 rpm. Pattern beneath panel rides on pin

By George W. Stanley, Jr.

Superintendent Aircraft Division
W. W. Kimball Co.

Resin Layers, Cross-Grain Plies Introduce Special Problems in Shaping Plastics-Bonded Plywood

ONE of the outstanding contributions of plastics to the world of materials has been the strength and stability which its synthetic resins have imparted to plywood. Originally, plywood, although stronger and more resistant to swelling, shrinkage and splitting than natural woods, was no stronger than its glued joints, which were far from resistant to moisture and mold. Through the use of synthetic resins, however, the very fibres of the plywood are penetrated, producing a new type of plywood, in which the resin when cured, becomes the chief strength factor in the panel, the wood acting merely as reinforcement.

Resin-bonded plywood possesses more nearly equal strength (and other properties) along the entire length and width of the panel than ordinary wood, greater resistance to splitting and much better dimensional stability. However, it presents somewhat of a problem in machining because it introduces two new elements: The presence of one or more glue lines, and the varying grain directions.

This powerful clipper is utilized to insure a perfectly straight bonding edge on veneers or plywood

Since the strength of wood across the grain is much lower than along the grain, by introducing a number of grain directions in a plywood panel, its strength may be more nearly equalized in any direction. Thus, any machining operation which tends to interfere with this balance in construction is a possible source of trouble.

Panel Sizing

Most plywood is sold as stock panels made in standard sizes 48 × 96" being the most common. The first operation in most plywood plants is to trim it to proper length and width.

Where production warrants, this is generally done on a

panel-sizer or on a double-end tenoner. Trimming to size consists of bringing the panel to net size in inches and to assure that the edges are square to each other. It is a well known fact that the set of the teeth and the number of teeth in a saw, whether a mechanical or hand saw, are entirely different for ripping than for cross-cutting. Since the grain is crossed in plywood, it is evident that if one is ripping the face, he is cross-cutting an inner-ply. Plywood cutting saws, therefore, must be mitered, that is, must combine rip and cross-cut teeth. This type of a saw generally has about four or five cross-teeth to every rip-tooth. The saw is not set but hollow-ground—thinner at the center than at the edge—and capable of making a very smooth cut.

The peripheral speed of the saw is about the same for cutting plywood as for lumber, with slightly higher speeds preferred for plywood if the proper saws are available.

The necessity for cutting one or more glue lines in plywood causes various types of trouble, depending on the type of glue.

Several different types may be used, including animal, soya, vegetable, casein and resin glues, the resins being by far the stronger and more waterproof for most applications.

The resin glues used for plywood, whether urea, phenolic or melamine resins, are all polymerized, or cured, during the process of making the plywood. Tests have shown, however, that maximum strength is not obtained for periods varying from 48 hr to 2 weeks after pressing. It is perfectly safe, nevertheless, if proper conditioning has been carried out, to do any machining on plywood after 48 hr. At this time the glue line is not quite as rough on saw teeth as it is a week later. In any event, it is evident that careful attention must be paid to the set and number of teeth in the saw and also to keep it properly honed or sharpened.

In machining plywood tools must be sharpened more frequently than in similar operations on solid lumber of the same species. It is becoming more and more the standard in modern plywood machining plants to call for high-speed steels for cutting tools chiefly because of the glue line problem.

Cutting speeds on plywood may vary depending on many circumstances. Ranges of 5-10,000 fpm are normal. In discussing the various machining operations on plywood, however, it is not possible to make specific recommendations with regard to cutting speed, cutting teeth, etc. When dealing with any given metal or plastics, a sample of that material will fall within certain limits as far as physical properties are concerned. In dealing with wood, however, there is such a tremendous range of physical properties that no set of bands will be applicable to wood as a whole. For example, the densities of common woods will vary from a specific gravity of 0.11 for balsa wood to 1.36 for letterwood, and tensile strength may range from 2000 to 15,000 psi.

Sloped at 15 to 1, scarf joint on $\frac{1}{16}$" aircraft plywood increases bonding surface. Steam-platen hydraulic press used to complete process. Note evenness of glue lines

Flat Sanding

Drum sanders using three or more drums are generally used in the flat sanding of plywood. The operation is essentially the same as in the case of solid lumber. However, if the sanding is too deep, it may go through the face ply, which would immediately spoil the panel for the pur-

To join plywood panels edgewise, they are first put into automatic jointer, which feeds own work, cuts and prepares edges for reception of resin, then applies it

Edge-gluing or splicing panels together is accomplished in this machine, which applies heat and pressure to the seam. Veneers as thin as .01" can be joined in this way

Dovetail joint being formed on two pieces of plywood at same time, with cutters revolving at high speed

pose for which it was intended and designed.

Stock panels are sometimes sanded on both sides simultaneously. Where better results are required, general practice is to sand the back first and face last. In this way a smoother bed is provided to give a very smooth face finish, assuming that the machine is adequate. Belt sanding is also often used for face finishes.

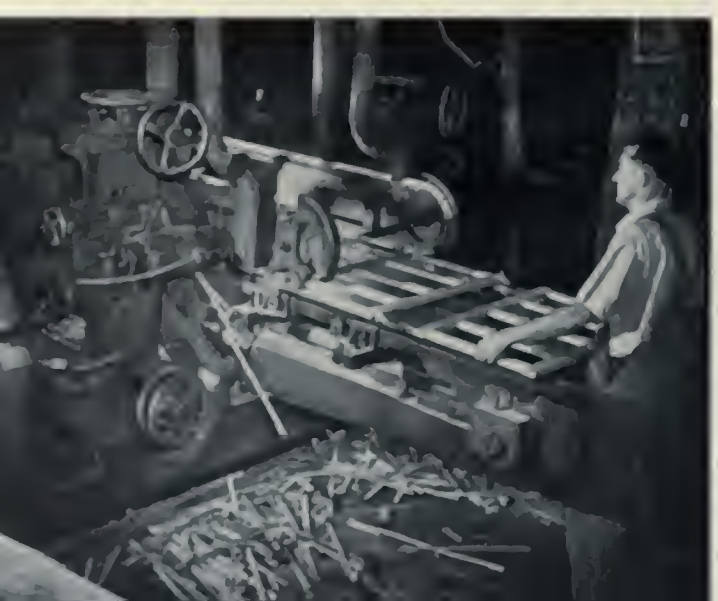
Curved plywood can be sanded on belt sanders, but inside or outside saddles will be required. In special shapes, such as the familiar *Toastmaster* tray, it is customary to sand the two ply faces and backs in the flat, before they are assembled and molded to final shape.

Care must be taken in the depth of the sanding cut if only one side of the panel is sanded. This is because a panel which may be of balanced construction before sanding may become unbalanced by having too much of the face thickness taken off with consequent warping of the panel.

Edge Sanding

A different problem is involved in the edge sanding of plywood than in flat sanding, although both are done on belt sanders or belt sanding attachments to panel sizers or tenoners. There are glue lines to contend with, and it is necessary to consider the particular glue used in specifying the belt particulars, such as coarseness, number of grit, speed, etc.

Laboratory cupboard parts being cut to length on a double-end tenoner, capable of 12 simultaneous operations. Left hall moves maximum of 10 ft to accommodate various widths



Scarfing

It is possible, through scarfing, to produce a plywood sheet of any given length, limited only by the size of the building in which it is made. Scarfing may be used to increase either the length or width of a panel; however, it is generally used to increase the length.

It is a well-known fact that if two pieces of wood are glued end to end in the normal manner of a butt joint, the weakest point in the resultant board is along the glue line. If these pieces are chamfered or sloped, however, an entirely satisfactory joint may be obtained.

In order to obtain a good scarfed joint, it is necessary that the slope on each piece be exactly alike. This slope will be determined by the purpose for which the plywood will be used. The longer the slope, the stronger the joint. The slope may vary from a ratio of 1 to 5 for a moderate strength joint to 1 to 20 for a joint required for certain aircraft uses. Thus it will be seen, for example, if we are to scarf inch plywood with a slope of 1 to 20, the chamfer or bevel would be the width of the panel and 20" long.

Special techniques have had to be developed to insure perfectly straight and uniform machining. The numerous glue lines in plywood serve only to complicate the problem. The machining for scarfing can be done in a number of ways, depending on the thickness, width and species of wood. It can be done in a planer by machining on an inclined saddle. It can be done in a shaper by building a saddle and using special shaper knives or profile saws. It often is done by hand. It can be done on a high-speed router if the length of the scarf is not too great. It can also be done on a jointer by building a suitable jig. A scarfing machine is just now appearing on the market. The final decision as to the best manner of producing a scarf will, in the final analysis, depend on the thickness and width of the panel and the purpose for which it is to be used.

One point of caution: It is not good practice to sand a scarfed joint except in extreme moderation and when it is done care must be taken to see that all fine particles of grit and wood dust are removed.

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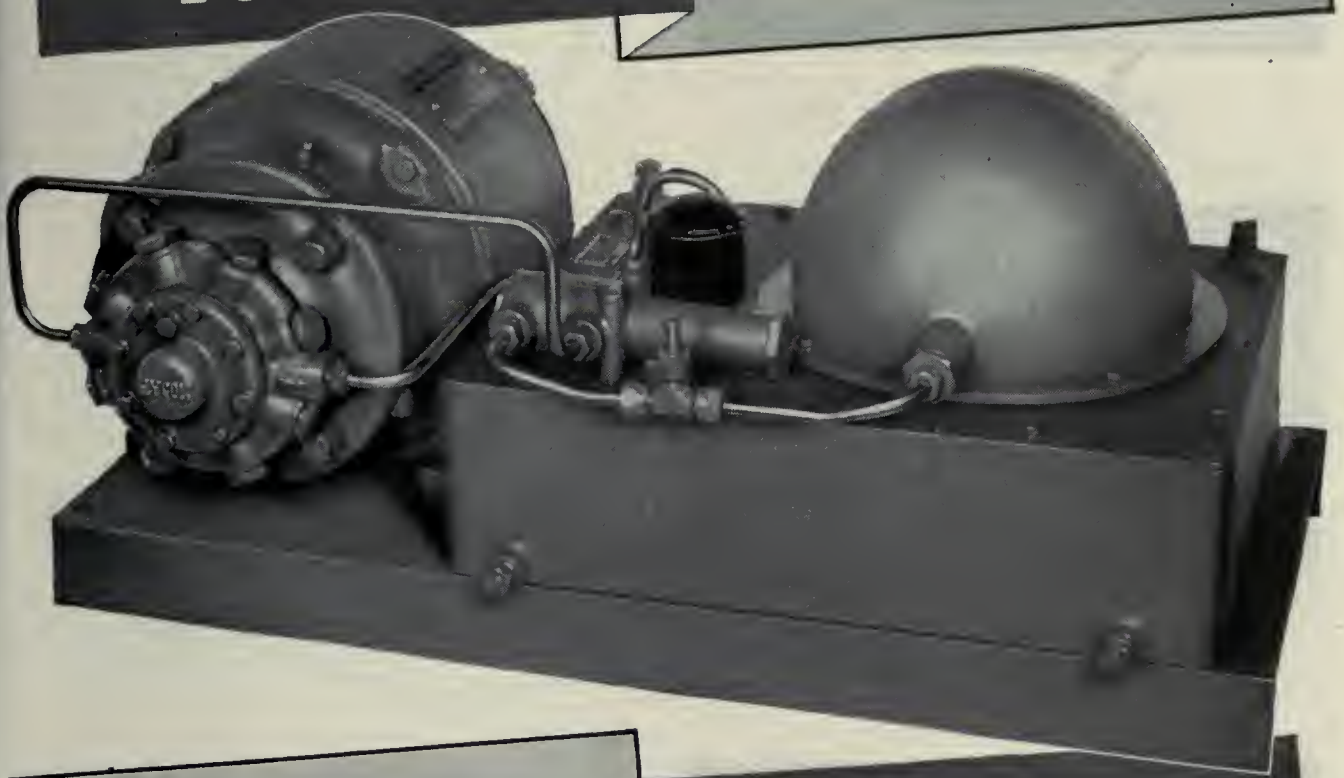

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Chain mortising operation, commonly used in fabricating the plywood stiles in light, honeycomb-type flush doors, takes its name from chain construction of the cutters

Edge-planing saves time. Above, power-planing, with spiral cutters rotating 18,000 rpm. High speed makes it possible to avoid tear-outs which occur in hand-planing thin plywood

Certain operations can best be performed on plywood assemblies with a shaper. The speed here is 7600 rpm. Work generally mounted in pattern riding against collar

Pressing of plywood is not under discussion here, but inasmuch as most scarf joints are assembled in hot presses, it is not out of order to explain how the scarf joints which we have just machined, are assembled.

The two parts of the scarf assembly are held together by one or more of several methods; such as paper tape, small staples, or spot gluing with a high frequency gun, and the assembly is then placed between the platens (generally heated by steam) and pressure applied. Close control of pressure, temperature and time is important. One of the accompanying illustrations shows a scarf joint of 3-ply fir-poplar-fir panels of 1/16" thick. In making this joint, a temperature of 300° F, pressure of 150 psi and time of 6 min were required.

Care is necessary in placing the assembly together so that the two scarfs match properly. If the machining is not accurate the pressure of the platens cause the pieces to slip, giving a poor joint. Scarfing is growing in importance but it is a much more critical operation than the run of the mill woodworking operation. It is definitely not the type of work with which the novice can be safely entrusted. At the present time, scarfs and panels all the way from 1/16" to 1½" thick would not be considered uncommon.

Band Sawing, Drilling, Jointing and Routing

There is no particular difficulty met in the band sawing of plywood except for the necessity of cutting across glue lines. Here we must take into consideration the effect of the glue line on the saw teeth. Since the grain runs in different directions, there cannot be too much set on the teeth. Care must also be taken to see that there is sufficient clearance.

Except for the fact that here again we have the problem of glue lines and their deteriorating effect on the cutting edges of drills, there is no great difference between drilling plywood and solid wood. In many plants it is now customary to use high-speed drills exclusively. Drill speeds for wood are considerably faster than for metal or plastics and, in general, it may be said that within practical limits, the faster the speed, the better the cut.

In order to mill plywood, it is necessary to use compromise saws and it may be required to joint the edges either on a jointer or a shaper. In either case, it is important that the knives be of a good grade of steel, properly ground, and operating at sufficiently high peripheral speeds.

Jointing may sometimes be dispensed with, but if accurate assembly work is required, it is a necessary operation.

Routing may be considered a specific form of drilling and what has been said about drilling may also be applied here. Routing speeds as fast as 24,000 rpm are not considered unusual at the present time.

One point of caution which should be pointed out is that in routing, dadoing or grooving of plywood, care must be exercised, particularly where these operations will cut across some, but not all, of the plies in the panel, for while the panel as a whole may be balanced, there will be unbalanced local conditions and this may cause considerable difficulty in the assembly operations. For example, it may be found that a dado cut was of the exact size required when cut, but by the time the tenon is ready for insertion, it will not fit. While these conditions exist to a certain degree in solid lumber, they are even more pronounced in plywood.

Dovetailing

As in most other milling operations with plywood, the essential difference between dovetailing plywood and solid lumber lies in the cutter life of the knives. Any knife which is continuously cutting plywood, especially where veneers are thin and there are many glue lines, soon has

(*Continued on page* 112)

COMPLETE PLASTICITY!

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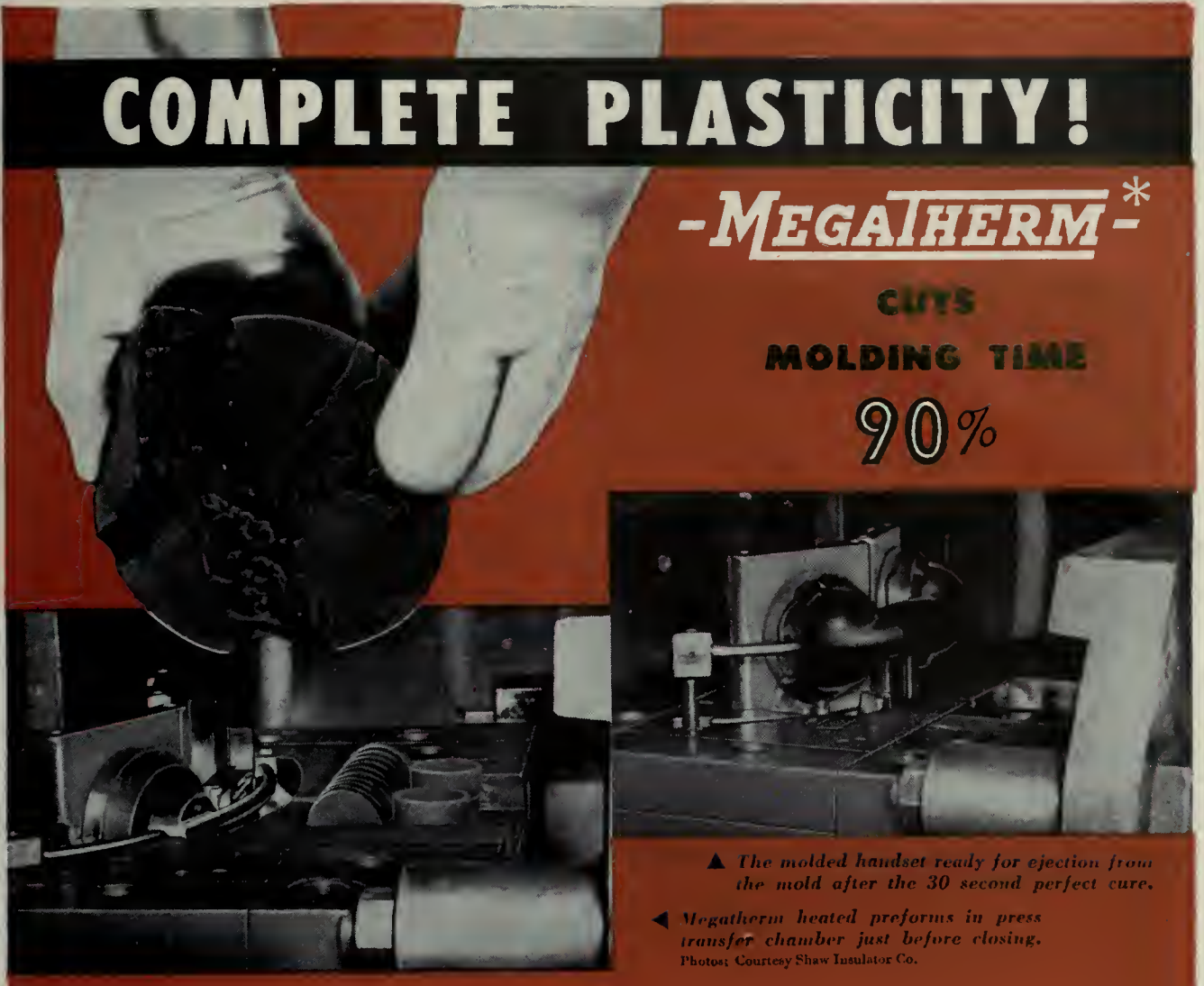
CUTS MOLDING TIME 90%



▲ *The molded handset ready for ejection from the mold after the 30 second perfect cure.*

◀ *Megatherm heated preforms in press transfer chamber just before closing.*

Photos: Courtesy Shaw Insulator Co.

Federal Industrial Power Tubes, give power and performance to Megatherm and other industrial heating equipment

Molding time on these telephone handsets was reduced from five minutes to 30 seconds with Megatherm.

In addition to rapid molding Megatherm provided a complete and uniform cure which was free of all internal stress.

Megatherm is doing plastic preform heating *better* and *more quickly* than any other method. In many cases Megatherm has made a plastic molding job possible which could not be done by other methods.

Megatherm units are compact, and may be easily moved from one production line to another. One of the four standard models will fit your production needs. Megatherm is available in 3 KW, 7 KW, 15 KW and 25 KW output capacities.

Cost of operation is low. The popular 3 KW Megatherm has a power cost of 3¢ per hour.

If you have a plastic preheating problem, now is the time to talk it over with Federal.

Federal Telephone and Radio Corporation

INDUSTRIAL ELECTRONICS DIVISION

*REG. U. S. PAT. OFF

WHAT TO TELL MACHINISTS ON PLAX POLYSTYRENE

Total pressure on polystyrene sheet, rod or tube is generally unimportant. Stress per unit of area over the contact surface is important. Polystyrene has a short time ultimate strength of from 7000 to 9000 p.s.i., but stresses of about half this value will cause "crazing" if applied too long. For this reason, care should be used in tightening clamping devices.

All surfaces should be carefully wiped, to prevent chips being clamped between the metal clamping surface and the polystyrene to be held. Covering the clamping surface with a thin rubber strip will aid in spreading the pressure over a large area.

Before constructing a jig, study the piece so that clamping pressures will not be concentrated at some remote point by previously machined holes or slots.

Steel is 70 times as stiff as polystyrene. Steel parts, such as automatic chucks or collets, which must close to a definite position should be set very carefully, to avoid crushing. For the same reason, machining at the outer end of a long overhang must be done so that stress concentration at the outboard end of the collett will not damage the next piece machined.

Hand-fed drills on semi-automatic lathes, especially when ⅛" diameter or less, should be mounted in a spring retained holder, so they will yield rather than be forced into the work if the operator overfeeds it.

In general, "crazing" due to cold flow, which can be caused by ignoring these cautions, can be prevented by properly planned sequence, well sharpened and properly shaped tools, and the avoidance of overfeeding. Bumping parts with heavy materials and rough handling of large pieces should also be avoided.

Where strains have been caused by cold flow or surface overheating, parts should be annealed as soon as possible after machining, to eliminate any tendency toward subsequent "crazing."

ANNEALING OF POLYSTYRENE parts, mentianed in the appasite calumn, is dane by Plax, which supplies palystyrene in sheets, rads, tubes and in the famaus Palyflex* Sheet and Palyflex* Fiber — taugh, flexible extruded forms with wide insulatian passibilities. Machined parts such as thase shawn abave are praduced by Plax ta your specifications. Plax alsa supplies a palystyrene cement.

Other Plax wartime praduction includes variaus forms af cellulase acetate, cellulose acetate butyrate, ethyl cellulase, methacrylate and styramic.

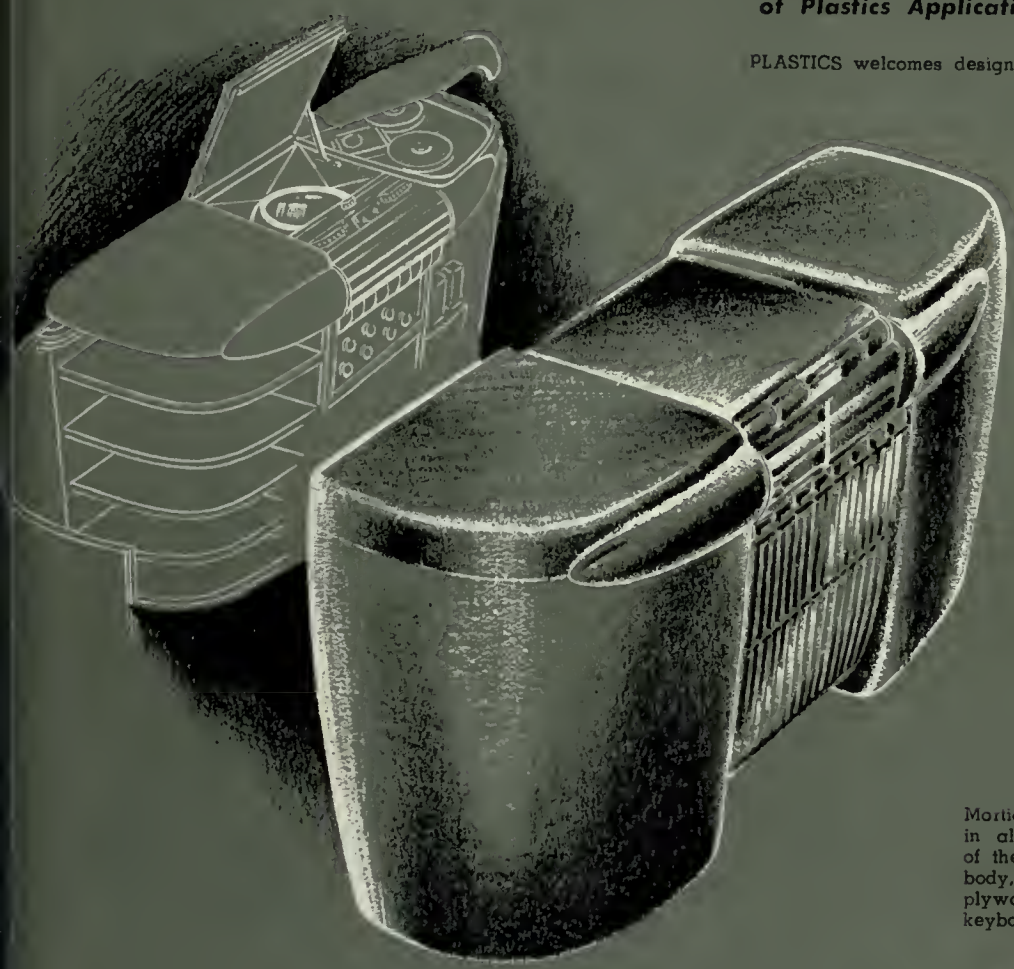
Write far "Fabricating Polystyrene," a bulletin containing full details of palystyrene's praperties.

*Trade Mark Reg. U.S. Pat. Off.

ON THE DRAFTING BOARD

Industrial Designers Present Their Visualization of Plastics Applications to Post-War Products

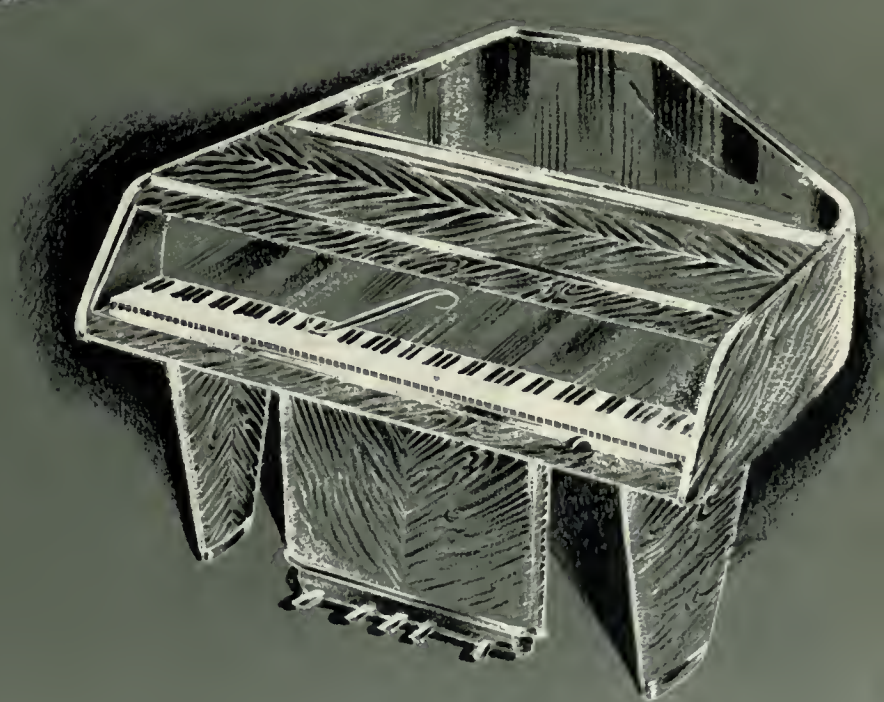
PLASTICS welcomes designers' contributions to this department



Designed by Sundberg-Feror, Detroit, low pressure molding will produce this highly stylized radio-television phonograph combination set. Featured are the magnetic wire type phonograph, and the transparent plastics radio dial in the center of the instrument

Martial & Scull have specified plastics for use in all parts of this piano with the exception of the metal sounding board and pedals. The body, legs and pedal stand show plastic-bonded plywood. Use of transparent plastics on top and keyboard cover permit view of piano's interior

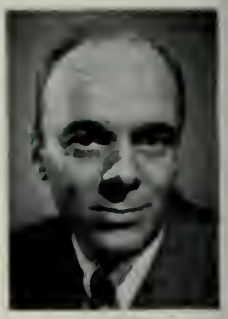
The use of transparent plastics lends individuality to this lipstick case. Its parts are analogous to those of a cigarette lighter, permitting the use of one hand for opening and closing movements. Initials may be applied as part of the Martiol & Scull design



Drawings by Julion Krupa
PLASTICS' Art Department

Let the Public Be Pleased!

By Roger L. Nowland
Van Doren, Nowland & Schladermundt



Pre-Production Market Testing Increases the Certainty Of Sales, Evaluates Performance of Products in Action

IN ORDER to succeed in its battle for product acceptance in the highly-competitive markets of the post-war world, the plastics industry will require a well-developed technique for determining the nature of these markets. Mere reconversion to pre-war practices and ideas—"going back to the old stand"—will not be enough. Like most industries, the plastics industry will find itself face to face with a war-educated consumer possessing new ideas and needs. This technique, intended to assure maximum consumer acceptance of products and equipment, must be based on a close-range study of "plastics in action".

No one is more strongly aware of the steadily increasing applications and limitless possibilities of plastics than the industrial designer. Because they combine function and appearance for better daily living, they will be leading post-war materials. Just as design will be one of the most influential factors determining product success in a highly-competitive market, so consumer acceptance of plastics will be of relative importance in the success of various product developments.

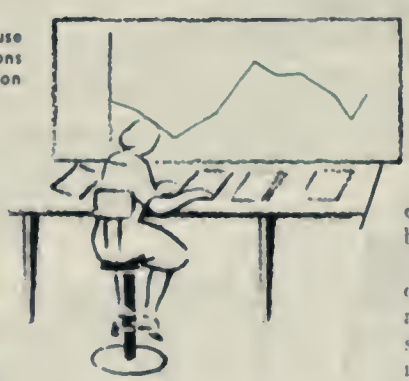
Although the horizons of product development have been pushed back immeasurably by the growing variety and applications of plastics, the more important factor to be considered is assured acceptance by the general public before production. In some respects, the picture is not as bright for plastics in the individual consumer market as it is in the industrial market, yet acceptance by the general market is vital since all new materials, products and equipment are in the final analysis reduced to terms of individual consumer use. Consequently, design for plastics must interpret their advantages in terms of the consumer.

Is it possible to assure consumer acceptance before production? It is not only possible, but essential. The potential size of the industry and its multiple relations with all other industry make it one of the strongest supports for a healthy post-war economy. For many years, industrial designers have been using plastics, alone and combined with traditional materials, with increasing success and appreciation for their contribution to efficiency and appearance. Yet assured acceptance before production is only possible through a technique of design that is based on consumer research, product engineering and visual design, translating the potential user's requirements and preferences into pictures and models that can be market-tested before final production.

It is important to note that the *method* of industrial design is what gives it much of its validity. As long as it holds to its technique, the field of application is secondary. The method for determining consumer requirements, wants and preferences for maximum acceptance is complicated, but its general approaches apply to any material or product. Research into consumer requirements involves consumer panels, house-to-house surveys, general study of present and possible use of specific products, a study of the environment in which any given product is to be used, the ways in which it is to be used, and the people who are going to use it.

EIGHT STEPS IN PRODUCT ENGINEERING:

ONE:—Survey consumer use of, need for and expectations of product under consideration



TWO:—Interpret the trends of the times affecting the needs and wants of consumer

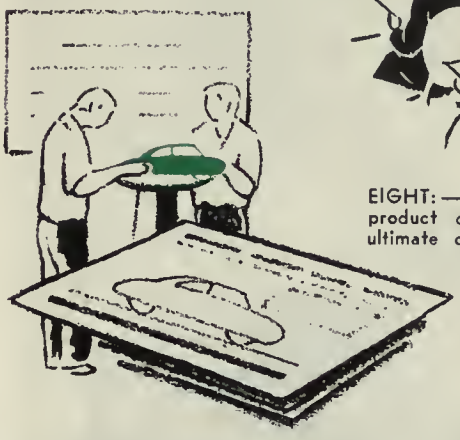
THREE:—Analyze functions of the product to determine its limitations, potentialities

FOUR:—Study assembled data to establish the functional requirements of the product

All this must be augmented by an understanding of general, economic, social and political influences. These broader issues constitute the background for specific cases. The correct evaluation of trends is important because requirements and tastes are conditioned by consumer reaction to these trends.

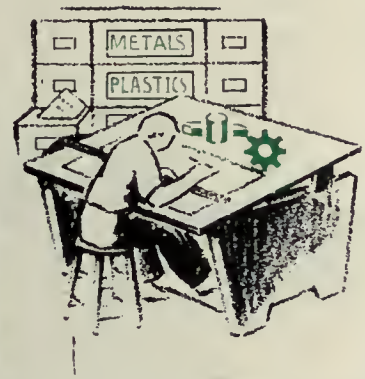
Product analysis combines research technique with an evaluation of the efficiency of a product "in action." At this point it is possible to set up at least skeleton specifications of product requirements, which can be immediately translated into renderings, drawings and models, visually understandable to any consumer market. It frequently happens that this dimensional interpretation does not completely measure up to the potential buyer's concept. In this case, it is extremely important to evaluate his criticisms and objections, and to repeat the process until there is an overwhelming acceptance of the designer's view of the proposed product.

SEVEN:—Create new designs and models with functional and visual consumer appeal



EIGHT: — Establish the final product design in terms of ultimate consumer preference

FIVE:—Field-test consumer reactions to fundamental, preliminary product conceptions



SIX:—Develop the product in terms of materials and techniques available to industry

Following this, the specific applications of materials and technical developments are taken into consideration, and are applied to the facts already determined. Although visual, creative design has been the ultimate goal consciously kept in mind, it becomes a reality now that concrete application has assured maximum acceptance. Thus, the consumer has actually been the first tool used in design. The final step consists of designs and models incorporating all indicated findings, which are consumer-tested again. Such a process develops a new and improved product with greater market acceptance.

Industry can no longer afford to be arbitrary in its post-war design of products. It has thought too long that it knew the consumer from the testimony of sales figures. Yet sales figures prove only the success or failure of any specific product *after* production. A thorough understanding of the user's relation to the product in action *before* production, is the only solution to the guesswork which has cost industry and business millions of dollars.

In pre-production testing, co-operation between the independent industrial designer and a company's own design department has been found to yield significant results. The independent designer, not being confined in his thinking by the firm's established precedents, often brings in fresh viewpoints—an important factor in re-conversion to a new post-war world.

Although consumer questioning has been a practice with many companies for some time, it has too often been exclusive and therefore had little bearing on the actual public reception of products. Some firms design three or four models of a product, call in their major executives and perhaps some employes of lesser rank to make a selection. This procedure often occurs when the product has already reached production. The persons questioned are generally prejudiced by their association with the company and the industry, represent a very limited cross-section of the public, and often have had only limited experience in actually using the product. Consumer surveys that merely give an opportunity of choice, without permitting widespread suggestions for improvement, or even complete rejection of the product, do not constitute impartial testing of the product "in action".

Although industrial design has been a recognized business only since 1927, the independent designer has too often been called in after a product had already failed in terms of sales, or after it was in production. Enlisting him before the product has passed the idea stage in many cases might have steered it away from failure. He can be of value in such situations since he is not working on one particular line, but on many different types of products and equipment and therefore has broader perspective. Because he works with diverse products, equipment and materials, he can readily see new opportunities for application of tools, dies and machinery in production of goods. His experience enables him to make use of existing plant facilities for expansion into related lines of production.

Industrial designers are not distinguished for their modesty in entering new fields. Their interest in plastics is an example. However, their concern with plastics is not a technical, material one, but is in the performance of plastics "in action," a phrase which has meaning only insofar as it is related to the final consumer. Many manufacturers have unfortunately treated the requirements of the ultimate consumer as a mere effect. As a diplomat's smile often conceals a mobilizing army, so the consumer's apparent acceptance of an inadequate product may conceal an incipient business failure.

An accurate understanding of the potential market is difficult to attain. It is usually impossible to estimate taste or requirements on the basis of statistical information. For instance, statistics show that 80% of the time, cars are driven with only one or two passengers. On the basis of this information, it would be reasonable to suppose that two-passenger cars were preferred by the majority of the people. The difference between statistics and an actual scientific analysis of the consumer in his environ-

Applying their product engineering technique to the Volley Upholstery Co. reception room, Van Doren, Nowland & Schladermundt evolved this design featuring extra-durable "Velon"

ment, is that 80% want five- or six-passenger cars.

All surveys and analyses must be consistently used to prove in what respects the designer-manufacturing approach is wrong. Ultimate maximum acceptance can be assured only by eliminating the 1% market complaint against any material, product or equipment, rather than sitting back satisfied with a 99% approval.

Melamine plastics used in H. Von Doren's Toledo counter scale design. Single-mold housing eliminates expensive finishing and makes the scale visually as well as functionally sanitary

The household refrigerator is one of the most clearly-illustrative examples of the correct approach. It is a common denominator of the American home, a product with which everyone has had some experience. There are approximately 12 outstanding refrigerator models, which differ very slightly in design and interior arrangement, to the point that the consumer himself has become accustomed to dealing with and adjusting to their inadequacies. It might be argued that this fact is reason enough for not changing existing models. However, some manufacturer will do so, and the entire concept of refrigerator design may conceivably be upset.

All companies have access to equivalent technical and scientific knowledge that makes for mechanical efficiency, but there is more to design and successful product development than technical perfection. An adequate approach cannot be made to changing the existing product without exhaustively answering the following representative basic questions: Who uses the refrigerator? How is it used? Where it is used? In what way can it more efficiently fulfill the user's requirements? What potentialities does the refrigerator have for additional uses?

In a study of kitchens, it was found that there were four different general types, and that use of the present standard refrigerator was often awkward in three of these. For instance, the opening of the all-over door presents a problem of non-accessibility in many kitchens, particularly the L-shaped type, where the alcove is the logical spot for the refrigerator. Difficulty of access becomes a major problem, since refrigerators are opened approximately 44 times a day in the home of an average family of four, involving waste time and motion.

Incredible as it may seem, surveys show that since a large percentage of the consumer market do not use ice cubes, they are under the impression that the ice cube compartment is primarily to keep the refrigerator cold! This fact instantly makes the customary position of the evaporator or freezing unit an unnecessary detriment to efficient use of space that could be better utilized for foods or staple products in continuous use. Usually, the long, narrow shelf adapted by its height for bottles, milk and other small containers is to the right of the ice cube compartment. The narrowness of this shelf makes it necessary to take out recent purchases in order to use what has been bought before, thus making double work, because all containers must be removed and replaced.

These are only a few of the minor faults in one commonly used piece of equipment today. The majority of products and equipment would suffer equally if approached from the standpoint of user convenience.

The unpredictable reactions of the potential consumer, clearly and constantly demonstrated by extensive research and analysis, forces the conclusion that any production run involving use of new materials must necessarily begin as a form of public relations, originating in pre-production, consumer-tested design.

Labelling and description of products offer another problem. The lay public is not interested in knowing that the plastic materials are the end products of many reactions following various combinations of wood, coal, cotton and gas. These are the interests of the organic chemists. Experience has taught us that the final consumer has colossal resistance to "simulated" glass fabrics, or any other material he considers a substitute. The general misinformed consumer belief that plastics are only substitutes must be corrected.

Good labeling should give the buyer the kind of information he wants. Labels have emphasized what the merchandise is, rather than how it satisfies consumer needs. The perfect label should do both. So far, the predominant

(*Continued on page* 106)

Planned Perfection

★ An estimate (of cost) is something much more than a means of determining a selling price. It is the point at which Cinch engineers give the buyer the benefit of their long experience. What is the best way to make it? What is the most efficient machine? Has the proper material been specified? What short cut or simplification of the assembly for economy should be recommended? These and many other considerations are all part of Cinch Service. "Planned Perfection", to our way of thinking, is not an accident—it is passing along our "KNOW HOW" learned through the manufacture of thousands of different metal plastic assemblies. Have you considered what our services can do for you?

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SUBSIDIARY OF UNITED-CARR FASTENER CORP., CAMBRIDGE, MASS.

No. 4 in a Series of advertisements "MEET MEtal Plastics Engineering"

CUTTER TOOL ECONOMY

By William Pike

Vice-President, Plytex Manufacturing Co.

Unique "Bite Board" Eases Choice of Used Shop Tools, Singly or in Combination, To Obviate Making New Tools For Machining of Plastics

Fig. 1. With above used tools and slight alteration in original design (drawing), cut shown (right) was made

MOST cuts of contoured cross-section taken in plastics materials are made with cutter tools milled and ground to provide the required contour. These tools, as a rule, are mounted in a milling machine or modified milling set-up, a beveling machine, a router or similar equipment, and generally the work is fed to the tool, rather than the other way 'round.

In a well-equipped and well established plastics fabricating plant, special cutter tools often accumulate until, in many shops, they total several hundred; in the smaller well-established shop there are likely to be at least a couple of hundred of these tools. And yet rarely has any plant derived the fullest use from its cutters.

A special cutter is made for a specific contour of cut and, at the end of the production run, is put away until the same cut is required on another job. However, that tool often can be used again on contours for which it was not originally intended. Use of only part of the tool can provide a new shape of cut, while a combination of the tool with others on hand can meet other new contour requirements.

This is no implication that utilization of cutter tools in part or in combination is unusual in plastics fabrication.

Fig. 2. In order to extend its cutting possibilities, the tool to produce the center sample was made in the three units shown below. The other two samples illustrate some of the additional cuts which these tools can make as units or combined

Experience Proves...

Changes in preform types DO require preheater adjustments

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2. **MAXIMUM PREHEATER EFFICIENCY**

...with *Airtronics* PREHEATERS

these necessary adjustments are made simply and quickly

For best results... Preforms of different shapes, sizes or materials require specific adjustments of preheating time, power output and load circuit tuning. The AIRTRONICS Preheater has these necessary controls located so conveniently that the setting can accurately be made in SECONDS.

It's simple as A - B - C... Controls on the AIRTRONICS Preheater need be set only once for each preform type. The unit then stays in tune indefinitely, creating exactly the right temperature for the precise time required to properly heat the preforms. Processing of large quantities of preforms may be accomplished in record time.

No technical training required... Press operators can adjust AIRTRONICS Preheaters for any desired output characteristic without technical training or knowledge of either plastics or electronics. Money and man-power are saved because of this flexibility and extreme simplicity.

Only three simple controls... The controls, just three of them, are located on the front panel at work-table height. They regulate preheating time, power output, and load circuit tuning, and are the ONLY ones that are used. There are no dangerous, time-consuming "inside changes" to make... no chance of the operator or the machine being injured due to carelessness.

Ask for demonstration... Until you have actually seen the AIRTRONICS Preheater in operation in your plant, you will not appreciate the amazing simplicity of this *advanced* electronic preheater. IT WILL PAY YOU DIVIDENDS to ask for a free demonstration. Write to nearest office, Dept. P

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Fig. 3. Tools as non-standard in cutting-edge contour as this one can be used for additional cuts if only a portion of the tool is employed. At the left, a full bite is shown; at the right, possible partial cut

Fig. 4. Two cutters produced the middle sample in two passes. Full bites from these tools shown at the sides

Fig. 5. Comparing samples from the bite board reveals contour possibilities in using combinations of cutters

Actually, it is common practice. The point being made is that the practice is not as extensive in the individual plant as it can be—despite the shortage of tool-making steel and tool-making labor. This holds especially for adaptation of *part* of the cutting edges of a tool to operations for which the tool was not originally made, although opportunities for combination are also overlooked frequently. The result is that, when a new design is submitted for production, one that contains a cut of a new contour, a new tool usually is made for the purpose, when a part of the cutting edge of a tool or a combination of tools—or, for that matter, a combination of parts of tools that are already on hand can perform the job. The trouble seems to lie partly in the fact that search in a big stock of tools takes patience and partly because it is not always easy to visualize the possibilities.

It was the need for a system which would simplify the work of searching for a required cutting edge and would facilitate the process of determining which tools, in part or in combination, would provide a cut of a required contour that led to the creation of a "bite board". This bite board is essentially an efficiency device, a time and money saver.

To make the need for such a system apparent, we will take some actual jobs as examples.

Recently we received specifications for an order on a design containing a cut whose cross-section is shown in the drawing inset in Fig. 1.

A single tool that could make this cut would take too much time and money because the cutting edges would round in to undercuts at two places, necessitating milling and grinding transversely into those points—an extremely ticklish job. Therefore, what was needed was a combination of tools which would produce the required bite—in this case, three cutters. We had in stock the cutters needed to provide the upper bevel and the middle round of the cut—the two cutters to the left in Fig. 1. We also had a cutter of the proper shape and cutting-edge dimensions for the lower round, but its diameter did not match that of the other two. This meant that the bottom round of the cut would have been out of alignment with the two upper parts of the cut. To provide the bottom round in accordance with the specifications would have meant making a new tool, but this would have taken at least two weeks.

We explained this situation to the customer and told him that we could work on his order immediately if he could make a slight modification in his design. We were informed that, fortunately, the moot part of the design was not unalterable, but that, considering the purpose for which the part was to be used, the vertical dimension of the cut

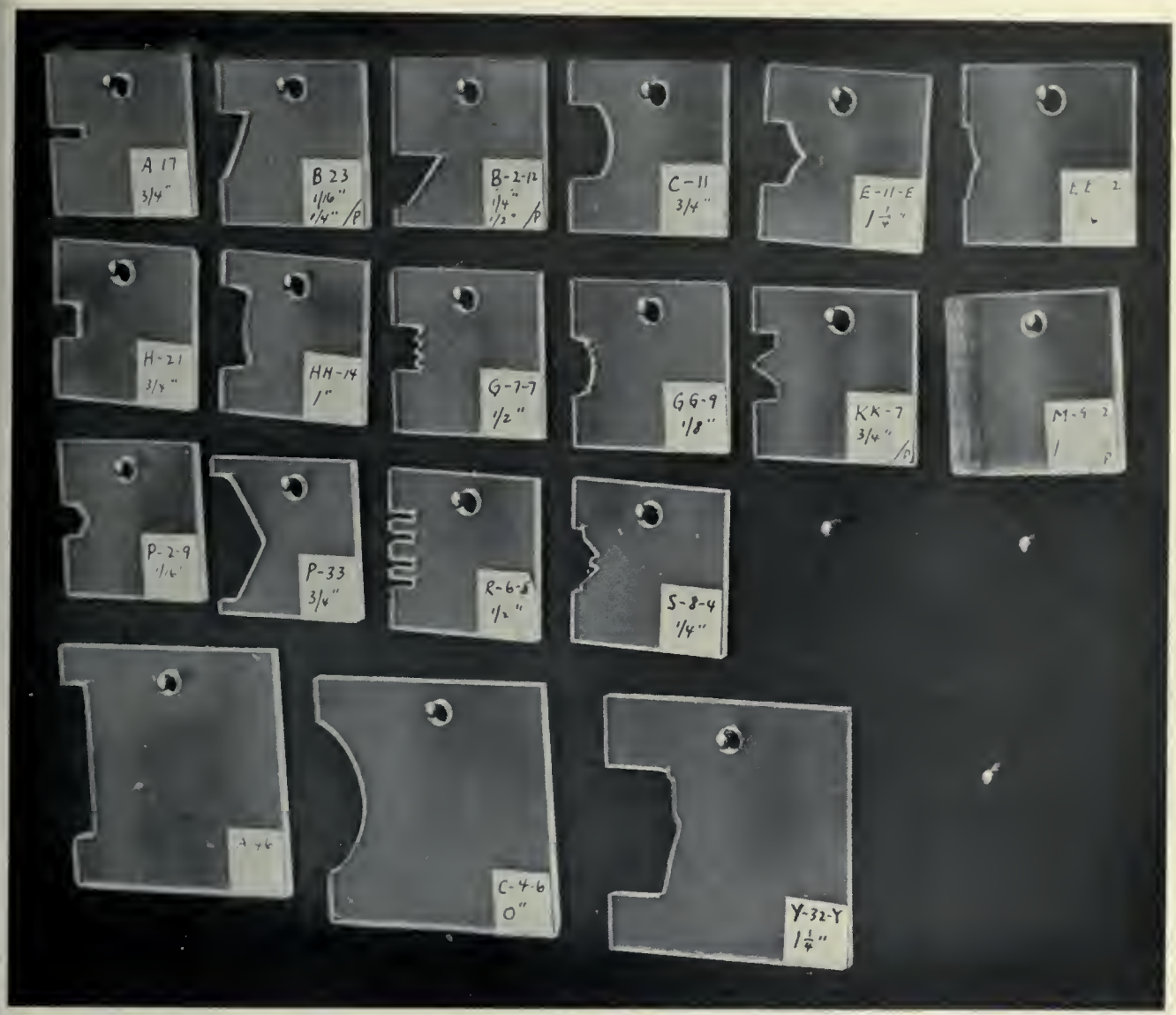


Fig. 6. The bite board, a system for simplifying the search for used tools and visualization of new contour possibilities from them. The board is of black phenolic, and the bite samples are of transparent methyl methacrylate

in question could not be changed, although the contour could. We searched through our cutter stock for possibilities. In succession, we combined the two upper cutters that met the original specifications with other cutters of various cross-section, of required vertical dimension and of matching diameter and took a sample cut of each combination. There were nine samples and there could have been more, if necessary. The customer had no difficulty selecting one of them. Thus we were able to start production on the order the next morning. In fact, the run was completed in less time than it would have taken to get the new tool. The cut for the changed design, together with the cutter combination that produced it, is seen in Fig. 1.

The procedure of combining old tools to meet a design requirement is often desirable for new tools as well. Such a combination of new cutters is shown in Fig. 2, the required cut being shown in the middle sample. There were several reasons for ordering three tools for combination, instead of a single tool. One was that it would actually have taken longer for the toolmaker to cut the single tool, since he would have had to tool a single blank in three planes, always more difficult and time-consuming than working in one plane. In making the combination of three separate cutters, each of them was tooled in a single plane, a simple job in this case, since all edges were straight. But there was another reason for three tools in combination rather than a single unit: they made available three separate cutters, each of them adaptable to another design and each of them combinable with other cutters for still other specifications. The sample bites in Fig. 2 show both the cut-contour for which the tool combination was originally made and other cuts available from it. It is obvious, too, that each of the bevel-edged cutters can be used singly to produce chamfers.

The reverse of combining tools to provide a required cut is the utilization of only *part* of a tool for a new contour. A point of objection might be made to the effect that the use of only a part of a tool wears down that area of the cutting edge and leaves the remainder of the tool as it was, with the result that, if the original cut is wanted again, the tool can no longer produce it. The answer is three-fold. First, if there is good reason to believe that the original cut will be re-ordered and if the same tolerances are to be observed, then the cutter must be preserved as it is. Second, if part of the tool is used and its cut-contour slightly altered, the cutter can be resharpened to return the cutting edge to its original contour (with a slight diminution of the original cutting-edge dimensions). The third answer is this: A great proportion of the cutters in stock are for non-standard contours. If, by the term "stand-

Fig. 7. Measuring a bite from the bite-board sample instead of from the cutting edges of the stock tool

ard", we denote the perfectly simple shapes, such as undeviating lines and curves, then the full bite of the cutter in Fig. 3 is non-standard in this sense. The cutter that made this bite, unless there is an expected reorder of the design, will ordinarily not be required again for a long time, if ever. There is, therefore, no weighty reason for not putting it to a use for which it was not originally intended. And it can be, as shown in the sample bite to the right in Fig. 3.

Combining Two Tools

It might seem paradoxical to say that there are occasions when a time-delivery requirement can be met more quickly by two operations than by one and yet we had an instance of that recently. Again it was a customer who wanted the job in a hurry. In the design was a cut of a contour which could have been produced either by a single cutter or by a combination of two diameter-matched cutters.

We had no tool like the former. Of the combination of two tools, we had one that had the required cutting-edge dimensions. We had a few possibilities, but none that would match the other one. In other words, we had no single tool or combination of tools that could have provided the required cut in a *single pass*. We could, however, achieve this cut contour by using one cutter for one pass and then doubling over on the operation by taking another pass using *part* of another tool we had in stock.

The customer was told what the situation was and it was pointed out to him that there were only two alternatives. One was to wait for at least a week, and more likely two or three, for a new tool. The other, if the customer insisted upon immediate production, was the double operation, with its correspondingly higher cost. To make the difference in price clearly evident, two estimates were submitted—one for the job with a new cutter used in a single operation and the other for the job which involved the two operations. Since time was an important consideration, the customer chose the double operation. In Fig. 4 is the result of that decision. The cuts normally taken by each of the two tools are shown directly behind their respective cutters; the cut made in two operations for the customer's required design is the one shown in the middle between the two full bites.

In a plant that has a considerable accumulation of cutter tools, they are either filed away in a cabinet or hung on nails on a board. In some plants, they are grouped by size of spindle hole and diameter of tool and, within these classifications, by similarity of bite, as nearly as can be. In those plants where an effort is made to efficiently apply old cutters to new designs, the foreman will usually go to the cutter cabinet or board, will remove one tool after another and glance at the cutting edge until he finds what he is looking for. Sometimes the tool isn't there at all. Sometimes, it is and he overlooks its possibilities because he does not visualize its application to the new design. The whole process of selection where there is a large stock is time-consuming, and one is not always rewarded with success.

The "Bite Board"

This subject came under discussion recently with Mel Meyers, special writer for PLASTICS. As a result, a "bite board" was devised which not only simplifies the selection of an old tool for a new application, but also makes the procedure efficient and productive. A section of the bite board is shown in Fig. 6. (Bite samples have been rearranged from their original groupings on the board to show variations of bite in the photo and to show sample bites from the various tools discussed earlier. The board is of black phenolic, but it may be of any dark-surfaced wood. On each nail is a small ⅛" wafer of transparent acrylic bearing a sample of the bite of a cutter. There is a sample bite for every cutter in stock. The nails on the board are spaced at such intervals as to allow for interpolation of sample bites from new cutters as they come in. The wafer is numbered to correspond with the number given the tool, with the spindle-hole size keyed into the tool number. Tool diameters are also clearly indicated on the wafer.

In the set-up described here, the tool is filed separately from the bite samples, but the bite board can easily be revised to associate cutter and bite sample on the same board. Bite samples are grouped, as far as possible, by similarity of bite. In cutting the sample, the tool is allowed to sink far enough into the wafer so that the complete contour of cut available from its cutting edge is exposed to view.

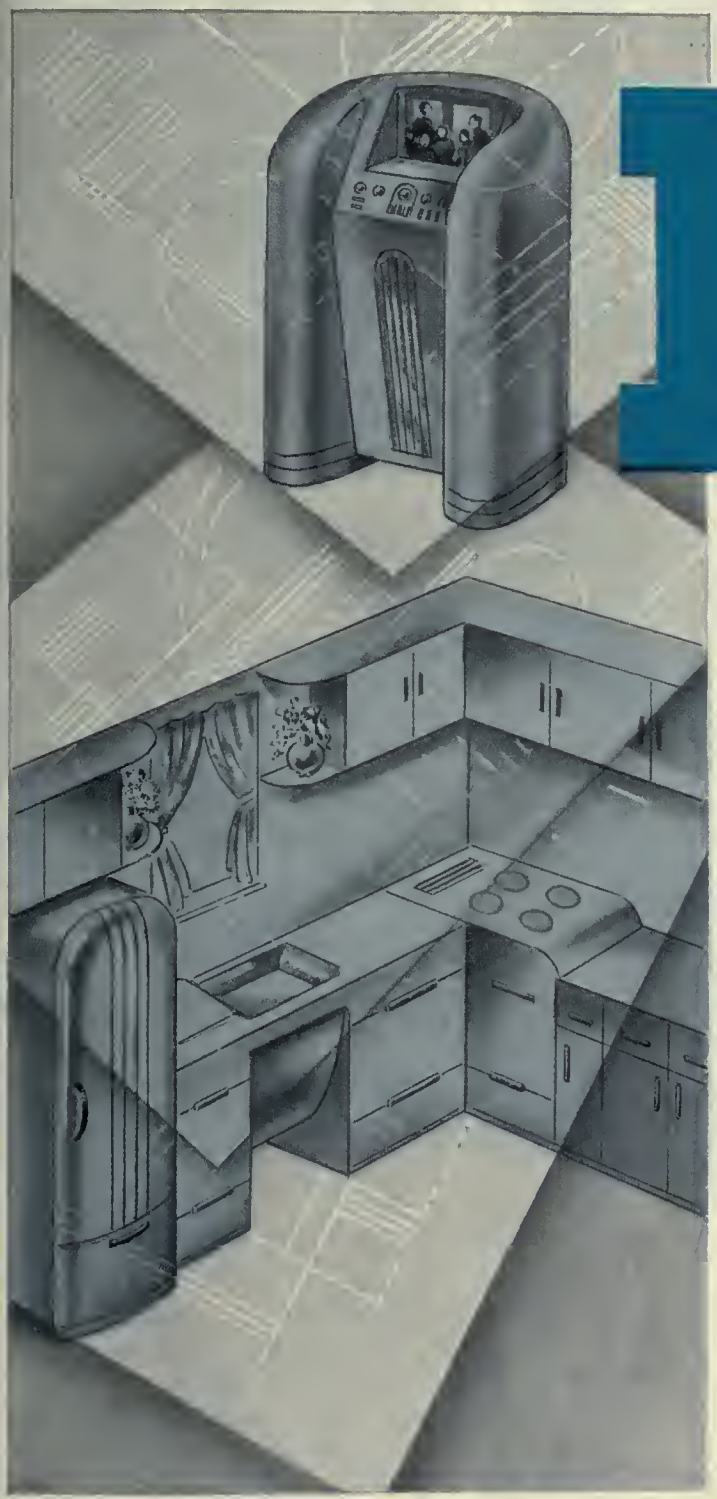
Selecting the Tool

When an attempt is being made to select an old tool or a combination of tools to meet the requirements of a new design, it is no longer necessary to take each tool in succession off its hook or out of its cabinet, examine its cutting edges and visualizing the probable results of the use of a section of the cutter or a combination of cutters. The visualization process is facilitated by the bite board, since it is necessary only to glance at the sample-bite wafers, to select the bites that would seem to meet the requirements and to make easy comparison with the design contour and dimensions. Where tolerances must be considered, measurements, whether as close as micrometric or as broad as caliper, can be made as easily on the sample bite as on the tool. In fact, the measurement of the bite is apt to be more exact, since the sample shows the actual produced result (Fig. 7).

While opaque white wafers offer a sharper and more easily discernible contrast against the black board than do transparent wafers, transparency offers a special advantage. It makes it possible to perform comparisons for teaming of bites by superimposing one sample on the other in the course of examination. This is shown in Fig. 5.

A cutting edge will dull with long use and will need

(*Continued on page* 113)



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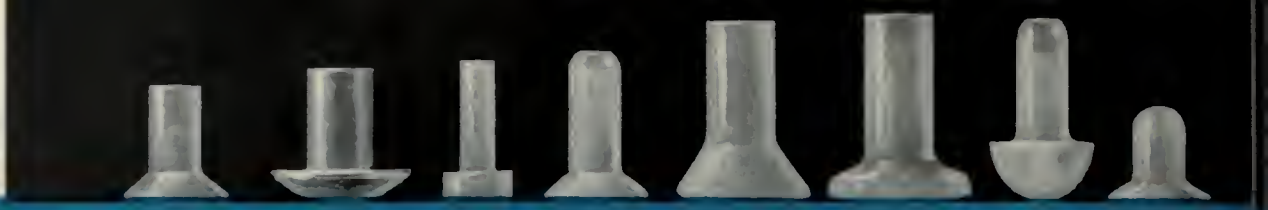


Testing Plastics Rivets

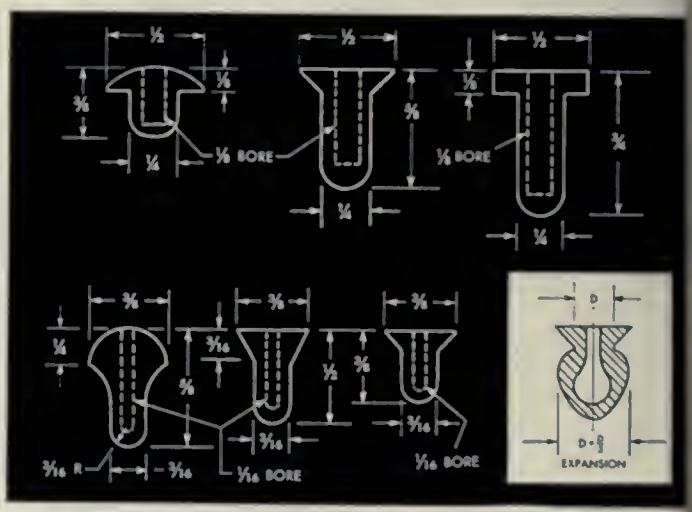
Besides Low Cost and Reduced Assembly Time, Plastics Rivets Offer High Tensile and Shear Strength, Stability at Temperature Extremes

IN response to numerous requests for data on the performance of its newly-developed plastics rivets, Douglas Aircraft Co., El Segundo plant, has conducted several exhaustive tests, which conclusively demonstrate that both acrylic and cellulose acetate rivets possess sufficient strength for a wide variety of important industrial applications.

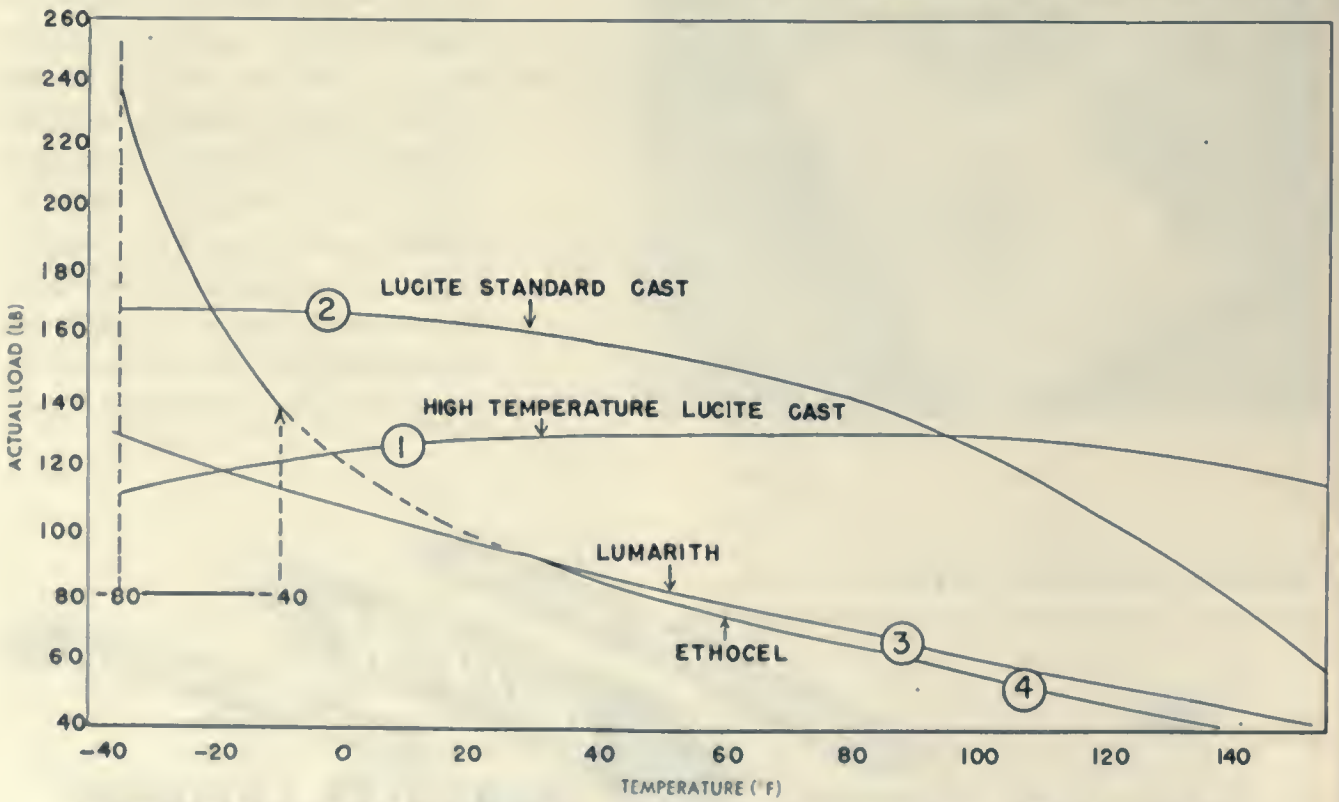
In an article entitled "Rivets Emerge in Plastics Form," PLASTICS (July, 1944) pointed out that such rivets opened a brilliant post-war future for plastics that had not been visualized before. Besides the immediate war use of the rivets in fastening fabric to airfoil surfaces and attaching upholstery in airplane cabins, these units could find considerable usefulness in decorative assemblies—back bars, wall panels and booths—also in such industrial applications as joining of fabric, rubber, plastics, and metals. Plastics rivets are extremely low in cost, and are surprisingly easy to install. This is done by preheating the rivet and then expanding the root end with compressed air.

Results of the tests, shown in the accompanying graph

(*Continued on page* 112)



Styles and dimensions of typical plastics rivets now in use



Tensile strength of plastics rivets at low and elevated temperatures. Tests conducted on ¼" diameter shank, 100° countersunk heads. Pressure and heat required for satisfactory driving: (1) 400° F, 70 lb; (2), (3) and (4) 300° F, 40

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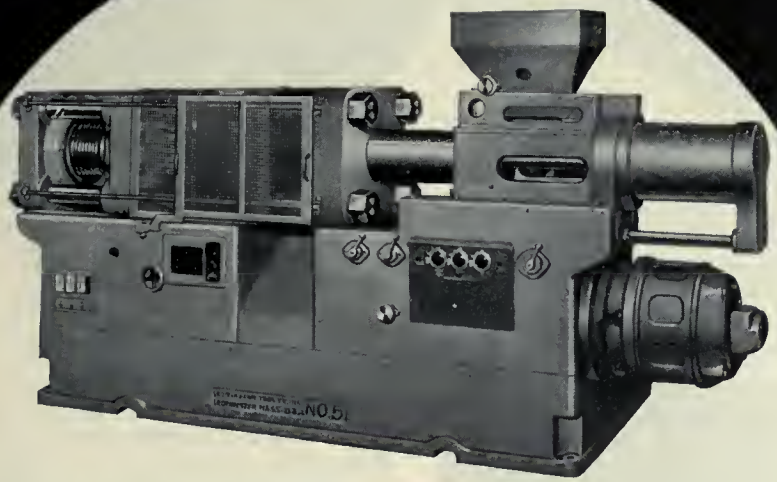
for PRECISION in PRODUCTION



Single die-plate adjustment by single screw for perfect die alignment. "Centralshaft" centralized movable plate support for equal pressure distribution.

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MANUFACTURERS OF MACHINES, TOOLS AND DIES FOR THE PLASTICS INDUSTRY

Cutting Magneto Head Rejects

High-Frequency Preheating of Preforms Aids Transfer Molding of Complex Aircraft Units

Fig. 1. Interior and exterior views of magneto head molded from "Melmac" preforms preheated with high-frequency

By Lyman L. Dawson

Vice-President, Charge of Thermex Division
The Girder Corp.

Fig. 2. Two plastics preforms with a total weight of 2¼ lb are placed between electrodes of "Thermex" preheater

BECAUSE it makes possible the heating of greater masses of molding materials rapidly and uniformly, the high-frequency preheating of preforms has made a substantial contribution to the art of handling larger and more complex plastics products. An example of this may be found in the manufacture of aircraft engine magneto distributor heads by the Diemolding Corp., Canastota, N. Y., which has placed its operation on a round-the-clock production basis, using as the raw material the asbestos-filled melamine compound, *Melmac*.

Molding of Bendix-Scintilla heads for a 12-cylinder aircraft engine was a particularly stubborn job, because of the low thermal conductivity of the compound, the size of the part, the close nesting of a large number of pins, and the complex arrangement of the 17 metal inserts (Fig. 1).

To secure proper flow from the transfer chamber into every section of the mold, the 2¼ lb of preformed *Melmac* had to be preheated to 250° F before it was placed in the loading well. Only by a rapid uniform heat could such a mass be heated to the center without, at the same time, overheating the surface.

When the core was underheated it could not be made to flow into the cavity except by using pressures which caused the pins to break or bend, and inserts to shear or move out of position. If the surface of the preforms were overheated in an attempt to soften the core, the compound began to set, causing equally disastrous results. Following 9 months of experimentation in preheating with electric ovens and infrared, work was stopped altogether on this job for several

weeks, in this particular plant, because of inability to reduce the number of rejects.

Diemolding Corp. then installed a Thermex high-frequency dielectric heating unit with enclosed preheater cabinet manufactured by The Girdler Corp. Within a week the molding of the Scintilla heads was proceeding on a production basis with the Thermex uniformly heating a steady stream of preforms and keeping two semi-automatic molding presses operating continuously through the 3 daily shifts, 6 days a week. One operator easily handles both presses. Fig. 2 shows the compact arrangement of equipment with the high frequency unit between two presses. The two preforms required to make one distributor head are being placed in the heating drawer at the right.

In the Thermex used by Diemolding Corp. the preheating is accomplished by placing the preforms on a removable cast-aluminum drawer which acts as the lower electrode and is readily closed into the preheater cabinet mounted on the side of the generating unit. This generator produces high-frequency power, which is applied to the preforms placed between the two electrodes. The dielectric loss factor of the material is such that the passage of high frequency electrical current produces heat within the preforms themselves.

The top electrode, also of cast aluminum, is adjustable; its position being indicated on the outside of the cabinet by a calibrated dial. The upper electrode is generally positioned to provide an air-gap above the preforms so the drawer can be freely moved. While the heating process is taking place, the operator sets up the 17 metal inserts on an assembly board from which he transfers them to keyed positions in the lower mold force of one of his presses (Fig. 3).

For this particular molding job two preforms with a total weight of 2¼ lb are placed in the drawer. After the compound has been heated to 250° F it is as plastic as putty. Opening the preheater drawer automatically opens the circuit and eliminates all danger to the operator. Any resumption of the heating involves the use of the starter button control on the instrument panel.

Because there is such close difference between the softening, flow, and setting up points of *Melmac*, a minimum period must elapse between the time that the operator removes the preforms from the drawer and the time he places them in the loading well of his press (Fig. 4). In this steam-heated well the heating process is continued throughout the press-closing time, during which the mold plunger is compressing the compound and transferring it into the mold cavity.

Completing the Cycle

With a pressure of 70 tons on the 12″ ram, the compound, which flows freely between 290° and 300° F, is forced through the two gates into the heated cavity. Here it is held under pressure for 5 min more before an indicating light signals the operator that the thermosetting reaction is completed, and that the finished head is ready to be removed from the mold (Fig. 5). It is believed that the gates used in molding the Bendix-Scintilla heads are the largest now in transfer molding.

A white thermosetting compound, asbestos-filled melamine has dielectric properties and cures into a light grayish-brown product capable of withstanding 25,000 v for 3 min and having a flexural strength of 10,000 lb. Its specific gravity is 1.78, and in the moisture resistance test it must show it can be submerged in water at 25° C for 24 hr and still have less than 2% moisture absorption. Rejects on the Scintilla heads before installation of Thermex high frequency equipment often ran as high as 30 to 50% of the day's output. Once the preforms were being heated with

(*Continued on page* 110)

Fig. 3. The 17 metal inserts are carefully transferred from assembly pattern to positions in lower mold force

Fig. 4. Operator places preforms in the transfer mold chamber quickly to avoid loss of heat; starts closing of mold

Fig. 5. Finished head is removed from mold after cycle of 8 min

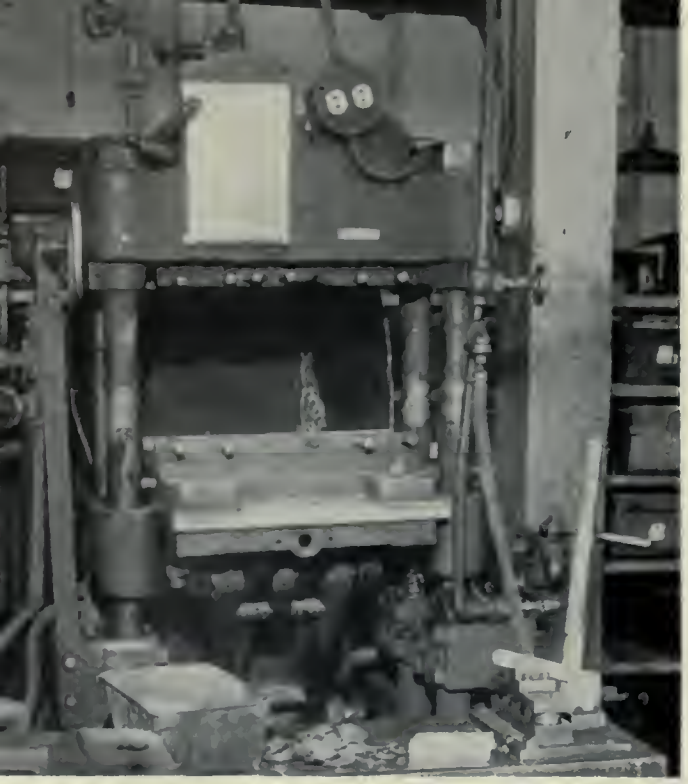

Fig. 1. One of 33 injection mold presses adapted by General Industries Co. to its purposes with compressed air

Fig. 2. Air-operated punch press equipment for removing flash. Note simple construction, easy control

Fig. 3. Steam-driven compressor of 880 cfm capacity provides the main source for the plant's air power

Compressed Air for Plastics Processing

By E. C. Powers

Educational Director
Compressed Air Institute

How One Molder Uses This Form of Power to Improve Shop Practice, Molding Machinery

DESPITE the public's enthusiasm and hopes for a post-war "plastics age," molders and fabricators know that they can expect strenuous competition for civilian markets from a wide variety of materials, once the pressure of war requirements is released. For this reason, any process or method which promises reduced operating costs and speedier production of plastics is worth careful study.

A vital factor affecting costs and speed of production is the type of power used in various plastics fabricating processes. One example of economies achieved in the use of power has been the experience of General Industries Co., Elyria, O., custom molder, which has found noteworthy applications for a type of power not commonly employed for molding purposes by the plastics industry—namely, compressed air.

The company found that certain non-hydraulic types of injection-molded presses had a tendency to jam when suddenly subjected to increased pressures, with resultant breaking of moving parts. A changeover to compressed air operation was decided upon as a "conservation" move. A study of costs involved in switching to more modern types of machinery indicated that the added investment would be too great in comparison with the application of compressed air to the existing machines. These units could be salvaged merely by substituting pistons for the older mechanism, and the effect would approach closely the advantages of hydraulic over other types of machinery. While actual financial savings cannot be disclosed, the company reports that they were substantial.

Compressed air had the effect of cushioning any tendency to "back up," and provided an even, steady pressing action. A total of 33 machines were adapted in this manner, utilizing the shop air pressure of 85-100 psi. One of these machines is shown in Fig. 1.

Developing 50 tons per sq in pressure, the machines are used because of their quick action in the quantity production of small parts.

A total of 142 compression presses and 7 injection presses are in operation. These include the 33 air-operated presses. The others are hydraulic and similar to those generally used by the plastics industry. Pieces up to 3 ft in diameter are turned out by some of the equipment.

Another ingenious, if not so uncommon use of compressed air at this plant is on a punch press operation. The molded

(*Continued on page* 101)

How

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Plastic TT Tubing fills ANOTHER new need

Lacey-Webber Company, of Kalamazoo, Mich., use 2" O.D. TULOX TT tubing as a replacement for glass in their nationally known "Freezgide". They find TULOX lighter, stronger and—for their purposes—*better.*

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Plastics

Use of du Pont's "Lucite" for gear case covers permits continuous readings of the vernier scale in precision cutting

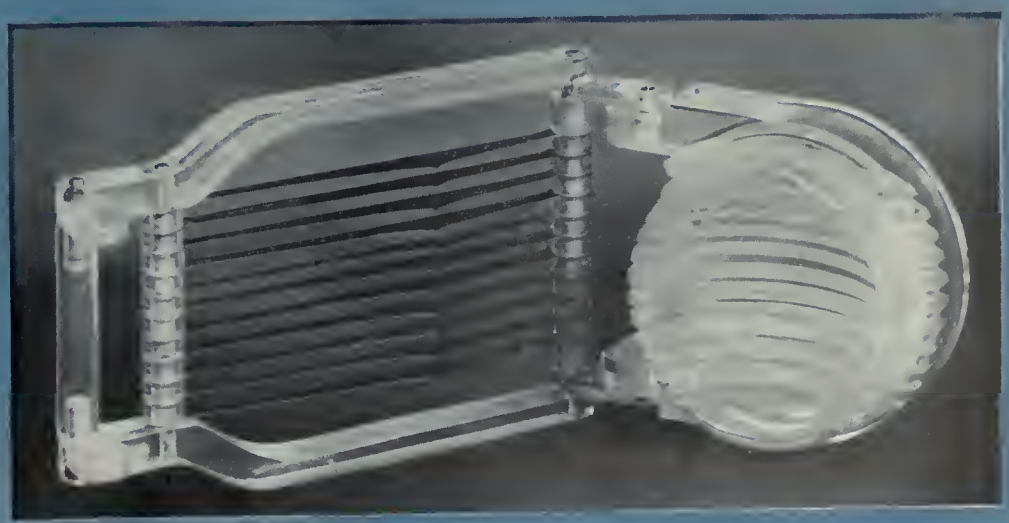
"Vinylite" resins were selected for tab-type wire markers for their many colors and ability to take printing

Transparent switch box injection molded from the Dow thermoplastic "Styron", a polystyrene with outstanding electrical characteristics

at Work

Designed for minor wounds, this new bandage produced by Medical Fabrics, Inc., features elasticity provided by Bakelite Corp. Vinyon

The transparent methacrylates used in this streamlined carry-all provide an attractive accessory which enables women to locate any desired article with great rapidity



he design of this acrylic tomato
icer developed by Jack Wingate
ves time and eliminates waste

Plastics

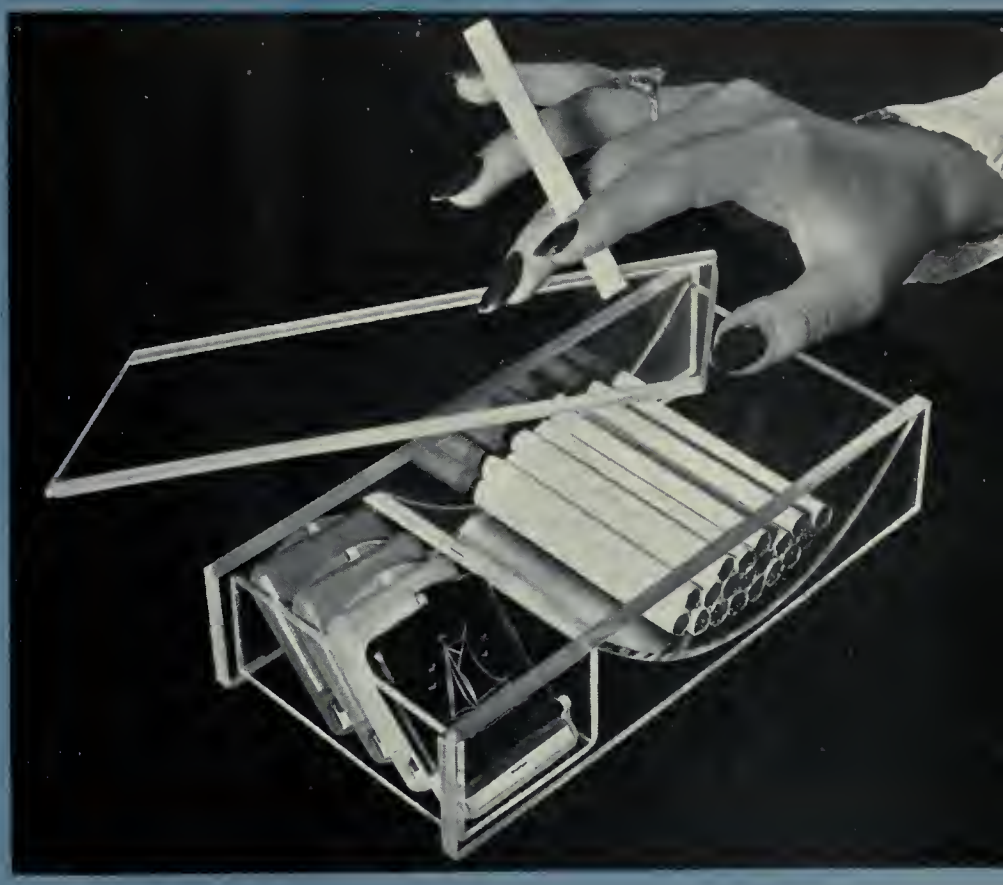
Full protection, plus the utmost in comfort is provided by safety goggles with shatterproof plastics frames. Lenses are interchangeable

Water seepage into high test gasoline
tems of aircraft is minimized by the
of alternate static vent drain of ac

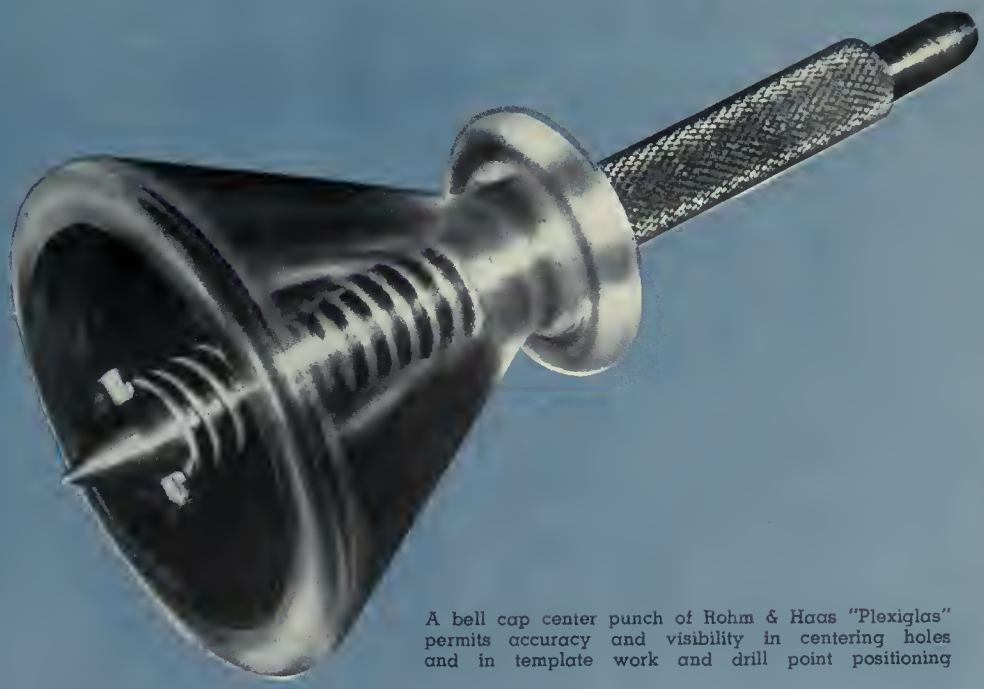
Looseleaf notebook binders made of "Tenite" allow sheets to lie flat, and offer simple, rapid exchange of sheets. Molded by Kampa

at Work

t Rohm & Haas "Plexiglas" in this cig- box has resulted in the production of ctical as well as a substantial utility



design at Wolf & Dessauer de- nt store is enhanced by the use ylic clock numerals, elevator sig- and illuminated colored strips



A bell cap center punch of Rohm & Haas "Plexiglas" permits accuracy and visibility in centering holes and in template work and drill point positioning

ACRYLICS for Tote Boxes

By Robert B. James

Industrial Engineer
Sperry Gyroscope Co., Inc.

Transparent, Dirt-Proof, They Protect Delicate Parts Enroute From Stock to the Assembly Line

IN reprocessing precision instruments for the armed forces Sperry Gyroscope Co. industrial engineers have developed many improvements and innovations intended to streamline the company's manufacturing methods. Delivery of delicate instrument parts from the stock rooms to the assembly lines proved to be an important phase of the study and led in two instances to the adoption of methyl methacrylate tote boxes.

The objective was to provide dirt-proof boxes in which instrument parts could be delivered in kit lots to the various assembly line stations in exact quantities for one shift's production.

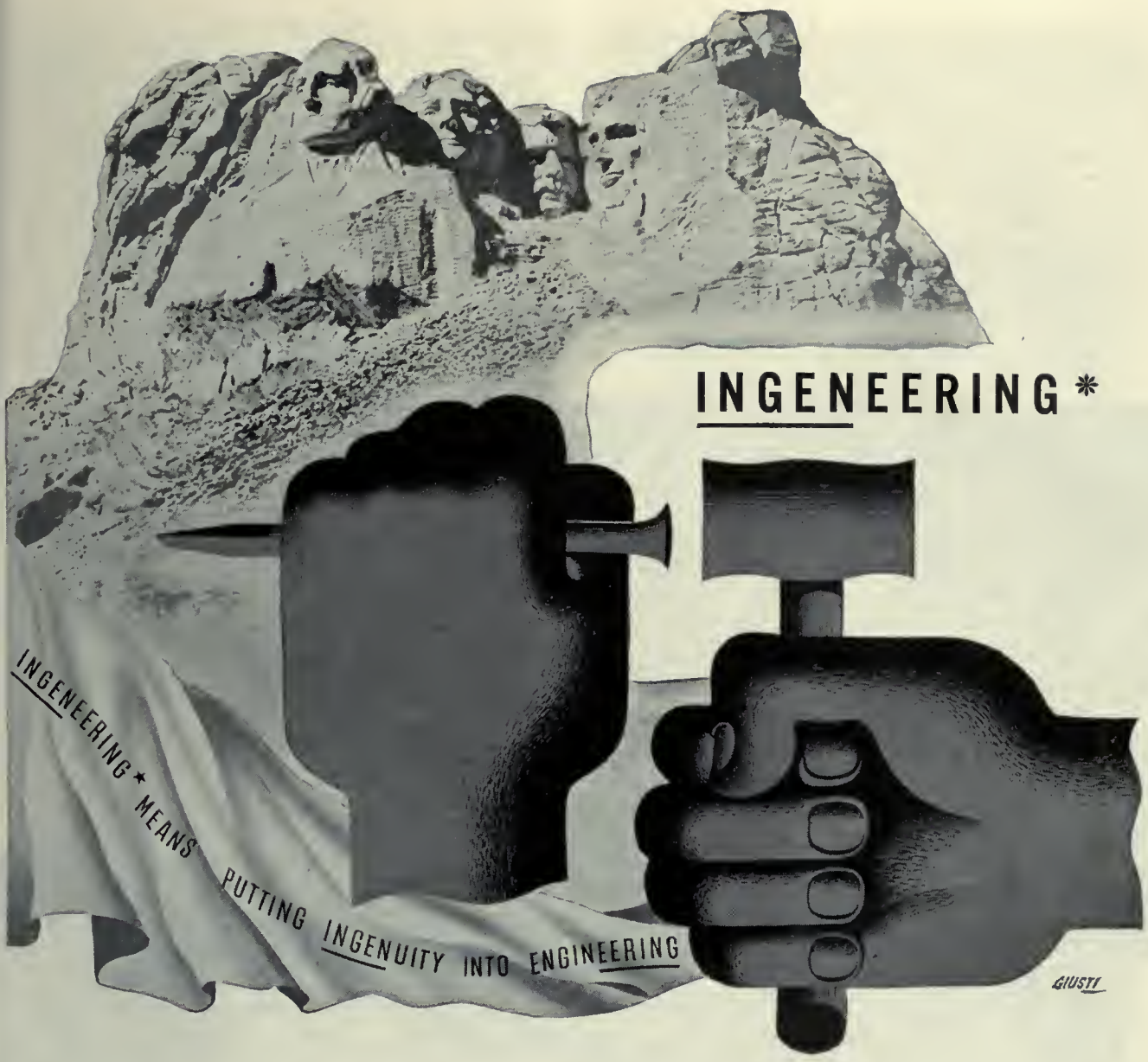
With a few exceptions, the conventional tote boxes used in the Sperry plants were soft pine wood with plywood bottoms, the entire box sprayed with shellac. Separators, when called for, were of the well-known cardboard egg-crate variety. The boxes were extremely difficult to keep clean. Splinters chipped off edges, crevices filled up with dirt and the surfaces sloughed off dust particles under the friction of normal usage. Modernization of assemblies necessitated procurement of an entirely different type of container.

In the manufacture of precision instruments dirt is a most persistent trouble maker. With the best precautions the wooden boxes were not satisfactory. Weeks were devoted to the search for a synthetic resin, lacquer or varnish with which the pine wood could be sprayed or otherwise treated to coat it with a tough, durable and crevice filling skin. Two or three possible solutions were found as a result of many tests but none was adequate. Simultaneous tests were made with numerous plastics, laminated and impregnated materials, fibres, hard woods and metals in an effort to find the most adaptable substance to replace the soft wood.

During the course of the box research the job became associated with a definite Sperry instrument re-processing project. Line flow assembly with full use of timed conveyors and every conceivable improvement was being established for the assembly of one of the important gyroscopic instruments. It was requested that special totes be procured for the delivery in kit lots of instrument parts to 75 different assembly stations in the new line. Each of the stations called for different parts, and in practically all instances necessitated individually-designed boxes for each station.

This acrylic box holds the exact number of parts for one shift on the company's instrument assembly line

A typical assembly line tote box and its dividing partitions, revealing clarity which facilitates inspection



It takes more than hands and tools and materials to create things that rise above the commonplace . . . whether in sculpture or in plastics.

It takes alert minds, willing to defy tradition, yet wise in the technique of their vocation, to make the difference. That's the *plus* you get when Victory Plastics puts INGENEERING to work to win superiority for your post-war plastics product. Write us. Victory Plastics Company, Design Street, Hudson, Massachusetts.

INGENEERS* OF PLASTICS PRODUCTS

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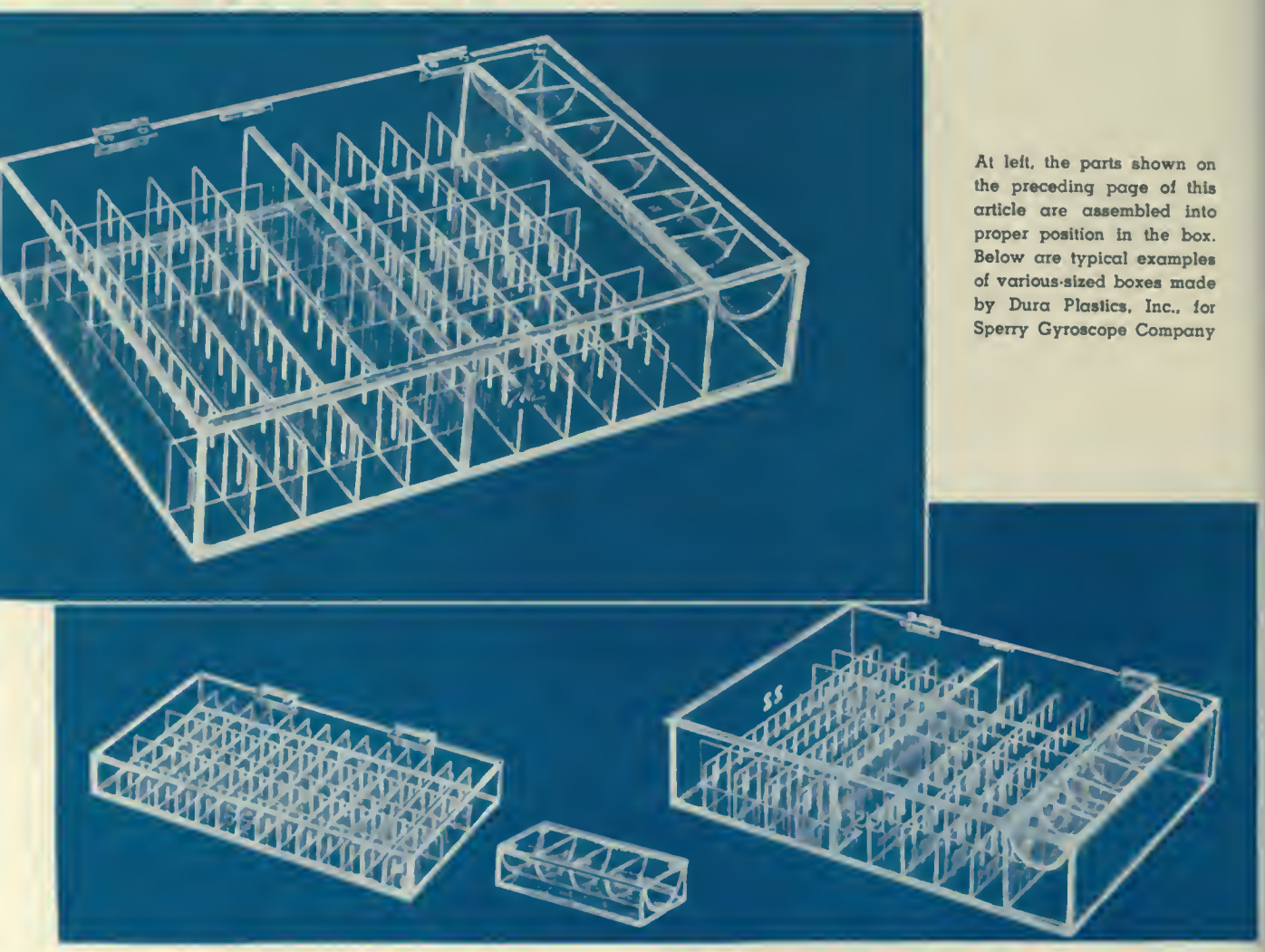
Not only must the boxes accommodate the proper quantities of each part but many parts required individual compartmentation to protect critically machined surfaces, delicate gears, etc., against damage.

The procurement department was to provide three times as many boxes as would be needed in the assembly line during any shift in order to have a second set being loaded for the succeeding shift and a third set held in reserve. Reference is made to this factor to point out that even with the triple supply of totes the initial order would not exceed 600 boxes. Such a quantitative limitation, with its variable box sizes, precluded, because of costs, any consideration of molded plastics. The job would have to be done, therefore, by fabrication and the next step was to decide upon the best material.



At left, the parts shown on the preceding page of this article are assembled into proper position in the box. Below are typical examples of various-sized boxes made by Dura Plastics, Inc., for Sperry Gyroscope Company

The study led to a decision to have the new boxes fabricated from clear methyl methacrylate. Both *Lucite* and *Plexiglas* were used. These clean, hard plastics lend themselves ideally to fabrication and in addition give the desirable advantages of transparency and beauty.

Transparency of the boxes and insets facilitates supervision. In the instrument assembly lines they permit immediate visual check of stock in work. Such information is important not only at the beginning of a shift but as quick reference to production in terms of time or to signal approaching part shortages. The beauty of the boxes is a decided incentive to good-housekeeping.

The relatively high cost of the plastics material and the hours of labor involved in making the boxes necessitated the adoption of designs which would assure a lasting and universal utility. This necessitated frequent alterations to interior compartmentation to meet shifting needs. Not only would production of the specific instrument cease in a matter of months, but engineering and methods changes frequently alter the distribution of piece parts at the various assembly stations, necessitating immediate alteration of the boxes in use.

The designers were given two jobs. First, the designing of a set of standard-sized boxes, half-round "cash box" trays, partitions and systematically-planned separators, from which complete tote boxes suitable for any small parts assembly could be put together. This job was to produce designs for a master set of tote boxes and insets from which all similar box requirements could be prescribed, irrespective of immediate needs. Second, a set of assembled boxes was designed for the specific instrument assembly.

The first half of the assignment produced designs for 8 standardized boxes, each with hinged cover, and in varying sizes. Dimensions included 15⅜x11⅜" with depths ranging from 1⅛ to 5", and 11⅜x6⅜", with depths of 1⅛ to 3".

In addition to the boxes the designs included a variety of half-round trays, to be used as box insets, to hold very small parts such as screws and lock-washers. The trays have 2, 3, 4, 6 or 8 separators, vary in height, corresponding to the various box depths. This was necessary

(*Continued on page* 105)

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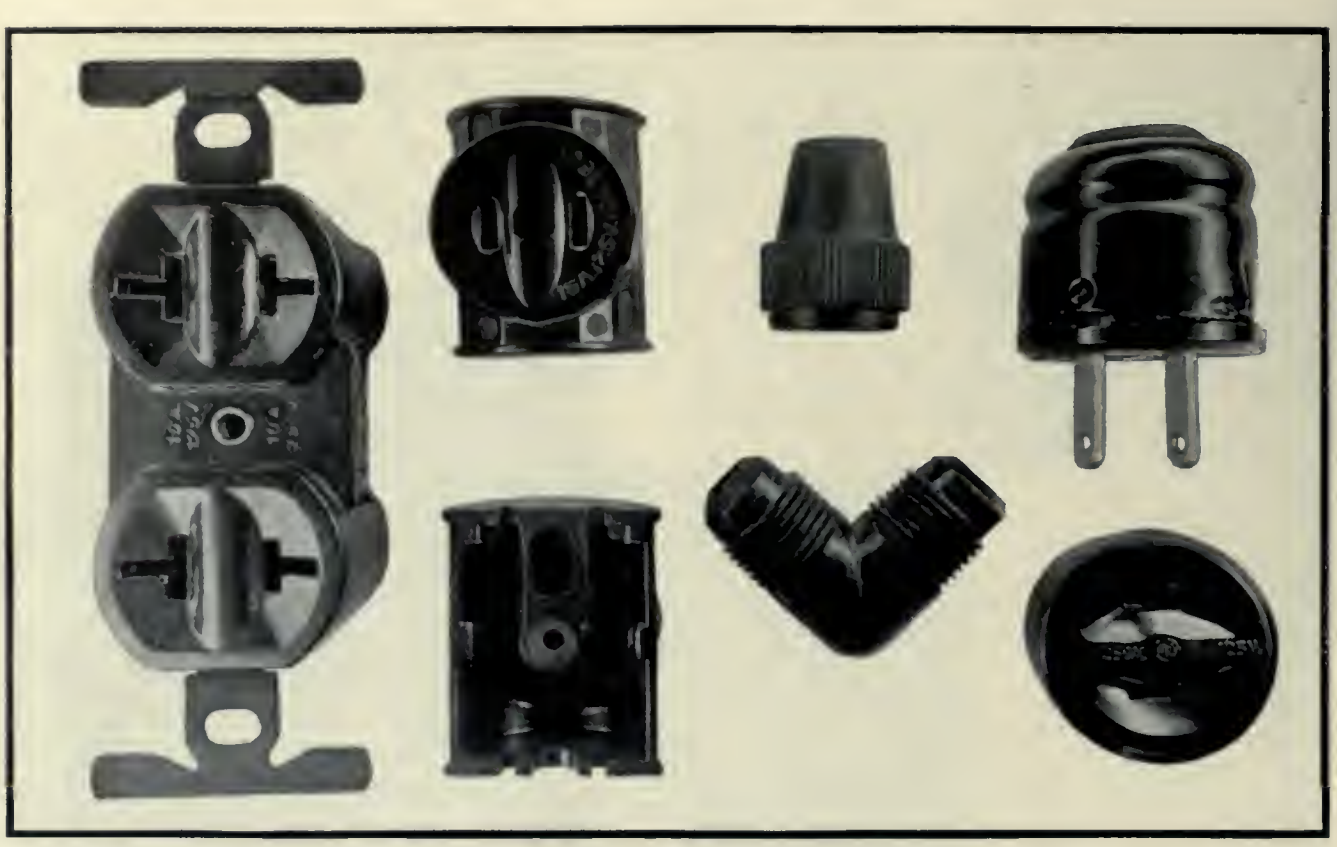


Three units at left and two at extreme right illustrate molded phenolic sockets coated with "Cumar" to improve their dielectric properties; also shown are threaded cap and connector made of hard rubber, china wood oil and "Cumar"

The Coumarone-Indene Resins

By Chester J. Zech

Versatile and Flexible, They Blend with and Extend Many Other Plastics; Improve Plasticity, Weathering and Flow

WHEN Japan paralyzed the American rubber industry by her Far East conquests, it became necessary to take immediate steps to convert our industry to synthetic production. As a result, chemists undertook extensive experimentation and research to ascertain what improvements could be made to existing synthetic rubber. Out of their work, they discovered, among other things, that coumarone-indene resins could serve as softeners and plasticizers for these new synthetic elastomers which were "too hard" and did not possess the elasticity of natural rubbers. At the same time, it was also found that coumarone-indene could be used in solving other problems.

Since numerous fabricators and molders of various end-products were being confronted by unusual problems pertaining to a lack of certain physical or chemical properties, their solution of these problems could very well lie in the proper use of coumarone-indene plastics, a truly versatile material. This is proved by the fact that, while it is too brittle to be molded as a primary base, it can be used as an adjunct with other molding compounds. By combining it with other plastics, electrical, chemical and physical properties can be altered and greatly improved at relatively low costs. It is known that by using this plasti-

Coumarone-indene resin varnish improves color retention of paints. The three light-colored panels are metal strips painted blue, coated with coumarone-indene resin varnish and exposed to sunlight for 6 months. Dark panels are strips similarly painted and exposed but not varnished

Coumarone-indene plays strategic role in these items: 1. As plasticizer in molded phenolic hinge; 2 and 3, as impregnant in laminated part; 4, as tack in synthetic rubber; and 5, as plasticizer in intricate molded unit made of a phenolic base

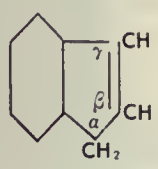
cizer one manufacturer saved 30% of phenol and formaldehyde. Considering all phases such as increased production, higher yields and conservation of raw materials, the added cost becomes negligible.

The Neville Co., Pittsburgh, was one of the pioneers in the development of coumarone-indene, starting in production of these resins back in 1925. Neville found available supplies of raw materials at the steel companies which were seeking to dispose of their coke oven by-products. Superior resins soon widened its domestic market, and the export field grew in importance until by the time the second World War began the company had sales agencies in all the important countries. Neville coumarone-indenes are marketed under various trade names, including *Paradene, Nuba, Nevindene, "R"* and *"G."*

Coumarone-indene is obtained by treating coal-tar naphthas (those boiling in the range 150-200° C) with sulfuric acid, which results in a precipitate. This is removed and treated chemically to neutralize the acid, and finally distilled to yield the "gold-dust twins," coumarone and indene, so named because of the difficulty in separating the two.

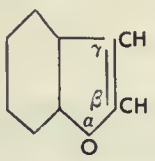
By regulating the various steps of production, resins are produced which range from semi-fluid viscous resins to brittle, hard resins; the colors are correlated from dark brown to pale straw. A feature of these resins is low cost.

Chemical representation of coumarone and indene is as follows:



$(C_6H_4CH_2CH{:}CH)$

Indene



$(C_6H_4OCH{:}CH)$

Coumarone

Modified coumarone-indene resins include such developments as *Nevillac,* alcohol soluble types, which are phenol condensates and have unusually wide compatibility. *Nevillac* resin is compatible with polyvinyl acetate and ethyl cellulose in all proportions and will also act as a mutual solubilizing agent between these synthetic resins and the regular coumarone-indene resins. These are used extensively in the manufacture of adhesives, paper coatings and artificial leather.

Coumarone-indenes are neutral, having an acid number of less than one, which is highly desirable in compounds where reaction with pigments must be avoided. An excellent application in this respect would be in enamels and certain protective coatings. Also, in being neutral, it is non-saponifiable. Thus, the resin would be particularly adaptable in end products which require alkali resistance. In addition, the resins resist water, brine and certain acid conditions, and so can be used for resistance to corrosive agents.

Coumarone-indene plastics possess good electrical resistance properties which should interest molders of specialties. Molded end-products of this material have an electrical breakdown strength of 1200-1400 mil of thickness, properties which are desirable in many forms of insulation, particularly condensers. However, the most important point in this connection is that this property is well retained despite conditions of high humidity or moisture. Electrical and weathering qualities are A-1.

Coumarone-indenes "stand up" well in compositions which may be exposed to moderate heat for long, sustained periods of time. This is possible because the resin possesses a high flash and fire point. Other interesting properties are: optical inactivity, specific gravity of 1.08 to 1.14, thermoplastic in nature.

Of singular interest should be the wide adaptability and ease of blending of the resin. It lends itself with ease and variance to other materials and vice-versa. Thus it is entirely possible to retain or introduce its good qualities. Coumarone-indene resin blends with:

Shellac	Chlorinated diphenyls
Vinyl acetate polymers*	Chlorinated rubber resins
Urea formaldehyde	Gutta-percha
Phenolics*	Hydrogenated oils
Chicle	Inorganic resinates
Polystyrene	Waxes
Acrylic ester polymers	Pitches
Cellulose acetate (up to 35%)*	Gilsonite
Phthalic glyceride resins	Asphalt
	Ethyl cellulose*

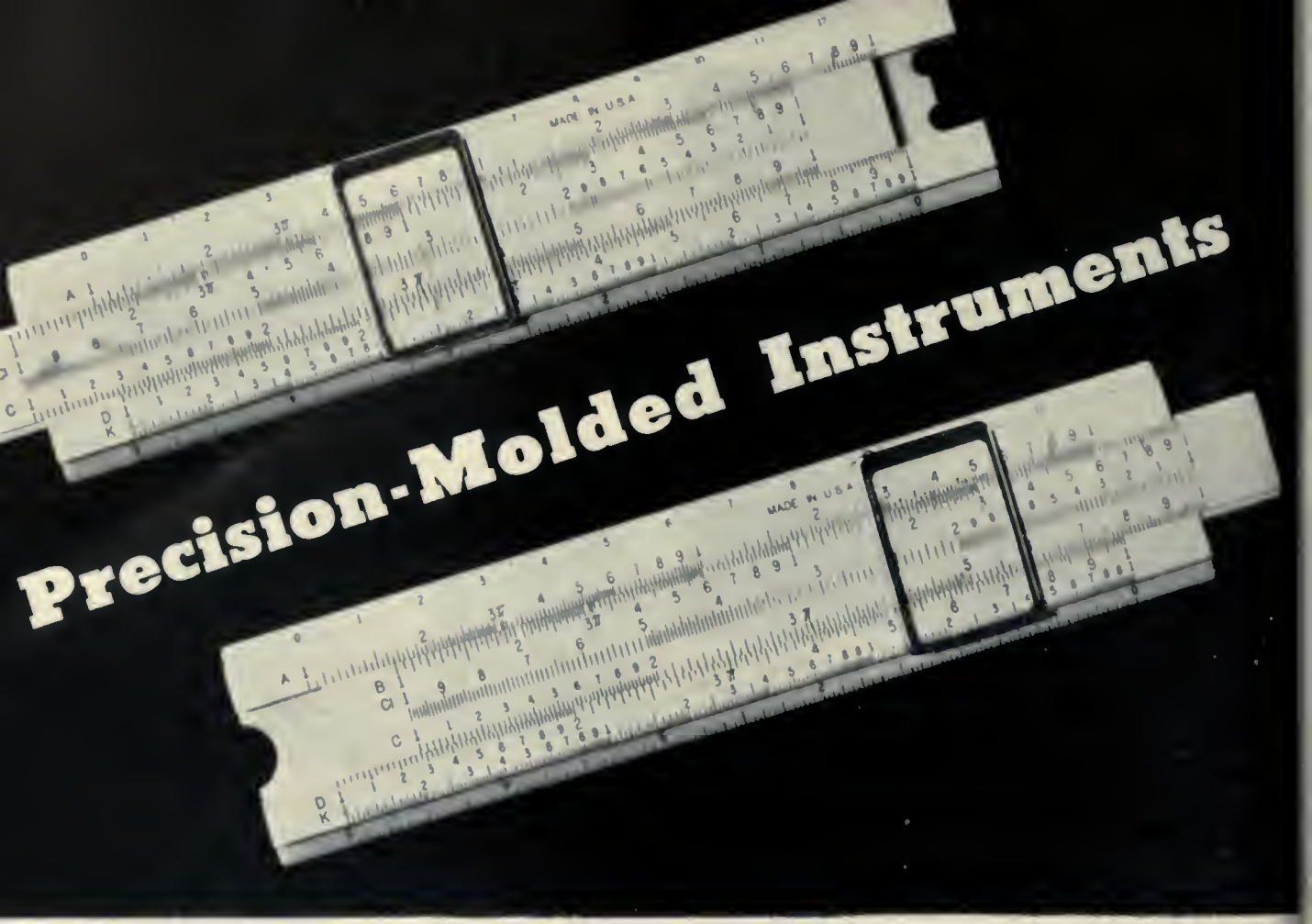
*Blends only with certain coumarone-indene compounds.

It can be partially blended with shellac, and can be blended with ethyl cellulose, although only in certain proportions; i.e., a maximum of 20% of high-melting coumarone resin, and in soft grades up to about 50%. *Nevillac* is compatible with vinyl acetate polymers in producing homogeneous thermoplastics of unusual toughness.

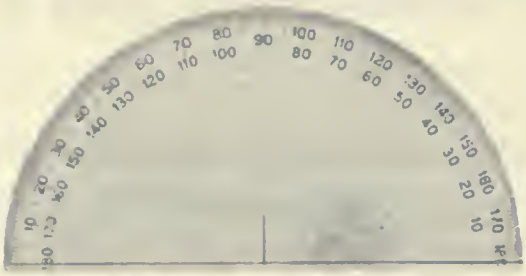
(*Continued on page 97*)

Milling, fidelity of record improved by fluxing with "Nevillac"

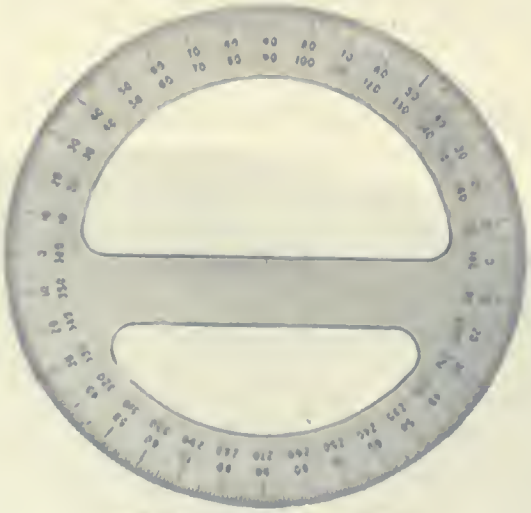
Precision-Molded Instruments



On the 5" pocket slide rule, molded of acrylics and polystyrene, tolerances are held to less than .0005".



Half-round polystyrene protractor, calibrated in ½° to 180°



Full 360° polystyrene protractor, also with ½° graduations

Plastics Make Possible Production Of Accurate Measuring Devices in Fraction of Time Formerly Required

PRODUCTION of vitally needed all-plastics drafting instruments has been increased materially through the development and use of a new technique in thermoplastic molding which couples hairline accuracy with speedier output of slide rules, protractors, engineers' and architects' scales and other kindred instruments.

As an example, some instruments, such as triangular relief facet scales, are completed and made ready for use in 24 hr by thermoplastic molding contrasted to the 2 to 3 years formerly required for turning out first-rate boxwood or celluloid-faced boxwood scales. Seasoning of the boxwood took 24 months, and if celluloid was applied, another 12 months was required for proper set and cure.

The instruments are being produced by the Pereles Bros., Inc., Milwaukee custom molders, by the injection molding process. Several different types of plastics materials are used, such as *Lucite* and *Plexiglas*; and Dow, Monsanto and Bakelite polystyrene. However, the accuracy and precision achieved in the dies has been responsible for the production attained. Using special equipment and methods in its engraving, tool and die departments, the company has been able to achieve a dimensional tolerance of .0005"

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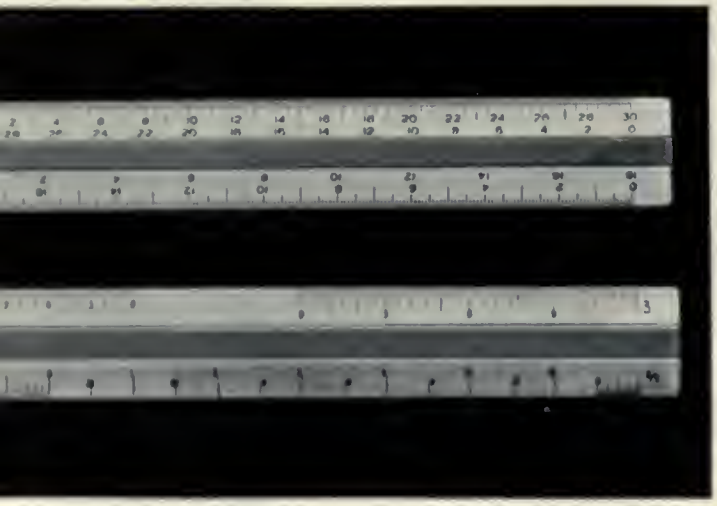
Acrylic triangular precision rules, which have as many as 2500 graduations and 60 lines to inch, can be made in only one day



Photos above and below illustrate the short and long size flat rules produced by Pereles with varied types of scales

per inch between lines as delicate as .003-.0035" in width of graduations or calibrations, on the various instruments, and a depth of .005".

How important this is in all the instruments is shown by the great number of lines necessary and the complexity and precision required on the dies. On the 5" pocket slide rule, for example, there are as many as 1600 lines, and double that number in the 10" type. On the triangular scale, one of the most common of all "tools" used by engineers and architects, there are more than 2500 graduations and as many as 60 lines to the inch.

The 5" pocket slide rule is said to be the first molded all-plastics type ever made; it uses the methyl methacrylates and the polystyrenes. Dimensional tolerances are held to even far greater accuracies between scales than mentioned above. There are different models with different scales, one of the most popular having scales of A, B, CI, C, D, K, S, L, and T, with millimeter and inch scales on the beveled edges. Both this rule, and the 10" slide rule, are fully adjustable. Screws on the back regulate the tension of movement of the slide.

Precision molding has imparted an advantage in that the dividing lines are deeper than they are wide, which not only increases the life of the instrument but also makes it easier to wipe-in the color.

Unusual precision also is attained in other instruments Pereles is now molding. Calibrations on the triangular relief facet scale for engineers are in tenths, twentieths, thirtieths, fortieths, fiftieths, and sixtieths of an inch; the same scale for architects has graduations as follows: a full size divided to sixteenths of an inch, a 3" per foot, 1½", ½", ¾", ⅜", 3/16", 3/32", ¼" and ⅛" all per foot, 1½", 1", ½", ¾", ⅜", 3/16", 3/32", ¼" and ⅛" all per foot; subdivisions for some of these scales are as small as 1/64".

Tests of the triangular scales under conditions of extreme humidity show that they are unaffected by high moisture content. Similar tests of the same scales made of boxwood with celluloid faces showed that the celluloid peeled or loosened from the base, making them useless.

Lucite and *Plexiglas* are used in these triangular scales, which now require only one full day for complete manufacture, including normalizing. With boxwood celluloid-faced scales, even after months had been required for seasoning and setting, the embossing of numbers and dividing the lines became a tedious task. In addition, considerable time is needed to emboss the scale.

The company is now also molding two types of polystyrene protractors, the most unusual of which is a full round, 360°, cut-out, beveled, 6" type, with ½° graduations. This model also features precision calibrations and speed of production and, in addition, saves substantial material. The other protractor model is the half-round type, having ½° calibrations graduated to 180°.

Plastics protractors of the cut-out type involved were formerly made by cutting from sheet stock. However, the cut-out portions were unusable for other purposes. Then, it was necessary to stamp-on the numbers, bevel, machine divide and finally emboss.

Pereles officials believe that in accomplishing and maintaining exact tolerances in quantity production of injection molded products, they have opened the way for widespread expansion in many other fields. Now that it is possible to make precision dies, such as are used in the drafting instruments, all products turned out from these dies are exactly the same. Most of the individual operations on each item are eliminated, thus speeding output and attaining accuracy without the need for highly skilled labor.

(*Continued on page* 111)

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CAPITAL Report

By Arnold Kruckman

Plastics' Washington Correspondent

NILS ANDERSON, Jr., sometime of the Bakelite organization at Bound Brook, N. J., is the new head of the Plastics Branch in the Chemicals Bureau of WPB.

Anderson (right) comes to the head of the Branch at a critical time. The short supply of formaldehyde had placed a double pinch on thermoplastics and thermosettings. It spelled less civilian production all around. It particularly hit those industries which had been given some small degree of relaxation for civilian production by means of Spot Authorization. The plants which found themselves with allocations of metals and manpower and other supplies to produce many urgently required civilian commodities, suddenly found themselves pinched in the supply of essential supplies made of plastics, and similar materials. In some instances, the suppliers of plastics parts had used their powders to make things not useful in the Spot Authorization program. They had made legitimate and sincere bets on potential needs for civilian industry and had bet on the wrong need, and the sudden draft on formaldehyde by the armed services apparently cut off more supplies.

It was Anderson's job to try to break this bottleneck, in order to get at least enough material to meet hardship cases. The sudden squeeze on formaldehyde stemmed mainly from the fact that the armed services increased enormously their requirements for ammonia. Both acetate and methanol obviously gave way to ammonia; phenol and phenolic resins were adversely affected. Anderson not only found himself confronted with the war demands that suddenly sprang from the need of more high explosives, more aviation gasoline, more acids, more ordnance, but he found insistent demands for more fertilizers and nitrates required by the essential industries which are an urgent part of the war program. This pressure disturbed the industry.

It is reported there has been relatively only a limited number of cut-backs in war contracts among the manufacturers of plastics. The trend is indicated by the fact that the overall unemployment resulting from anticipated cutbacks in *all* war industry has been almost negligible, the latest figure being something around 85,000. The word is that the armed services have steadily opposed most of the Spot Authorization designed to start civilian production. There has been a consistent and persistent effort to smother more discussion about reconversion and post-war planning. It is inevitable, however, that the potential end of the European war, predicted widely for the middle of October, should have temporarily brought war production in some plastics plants to a standstill. This posed the problem what these plants might do during the interim to hold their skilled labor. In some instances they have already received new war contracts, but the new product usually requires some re-tooling. In one case, at least, the workers were kept in employment by making a civilian commodity with military approval, albeit the commodity had to be made in a less finished form than is usual in normal times. But this production permitted the plant to keep going while the re-tooling was in progress.

Fortunately, Anderson, together with other members of the Chemicals Bureau and representatives of the industry, has worked on a program to ease the present critical situation of plastics supplies, and it is expected a solution may be formulated early this month.

If the German war should end, as the result of the impending drive, it is anticipated there will quickly be available larger supplies of almost everything. And it is regarded as fortunate that the plastics industry is not appreciably affected immediately by the operation of the new Law 485 which has established the Office of War Mobilization and Reconversion. This Law contains a mandate which has serious implications to those industries which were in existence before 1942. Under the so-called "Industrial Grandfather Clause" it is a principle of reconversion that, when there is competition for materials which are short in supply, those industrial units in existence before the war have a prior right over those which came into existence after the war. The new law sharply directs that all plants, new or old, no matter when they came into existence, mandatorily have a right to a "fair and equitable" share of materials or equipment available for distribution.

Administering the Reconversion Law

Administration of Sections 203 and 204 of the Law largely come under the supervision of the Smaller War Plants Corporation. Maury Maverick, Chairman of SWPC, has just issued a statement of his plans in a Report to the Chairman of WPB. He says:

"The Reconversion Law is of tremendous importance to small plants in the Reconversion period. Sections 203 and 204 contain three negative and two positive directions to executive agencies. Specifically, the negative directions *outlaw* the 'Industrial Grandfather Clause' principle of reconversion—the principle that no plant can make a civilian product in the reconversion period unless it made that product before the war. Similarly, they outlaw what has become known as the 'Cherokee Strip' principle of reconversion—the principle that all producers of a civilian type product should start at the same time, of course, holds up small plants until their larger competitors have finished their war work. The last of these three negative directions is even broader. It provides that in the resumption of civilian production on a restricted basis, no small plant 'capable and desirous' of participating in such resumption can be prevented from participating.

"The positive or affirmative features of the Act are, first, that the resumption of civilian production should be permitted as soon as materials, components, facilities, and labor, are available; and second, must set aside a percentage of such material for the exclusive use of smaller plants. The amount of the material to be set aside is to be determined under the Act by the head of the executive agency, after consultation with the Chairman of the Smaller War Plants Corporation. Furthermore, the material so set aside is to be distributed in accordance with 'criteria, standards, quotas, schedules,' or other conditioning factors to be established by the head of the executive agency after consultation with the Chairman of the SWPC. (A small plant

is defined in the Act as one *that employs 250 wage earners or less,* or comes within such other categories as are decided upon by the head of the executive agency and the Chairman of SWPC.

"The SWPC will naturally perform certain duties under the Act. The SWPC will endeavor to notify all small business men that they cannot be kept out of civilian production merely because they did not produce an item before the war or because any of their competitors are engaged in war production. In addition, whenever the War Production Board resumes civilian production on a 'programmed basis' the SWPC will endeavor to see to it that all small plants which are 'capable and desirous' of participating, are included. (The distinguishing feature of 'programmed' non-war production is the issuance by WPB—of which OCR and Plastics Branch is a part—to individual producers of a production schedule—in dollars and cents or in units—together with an allotment of materials for the production of a given product, e. g., electric flat-irons.)

"Finally the SWPC will perform duties directed to it by Congress in the work of setting aside the materials for the exclusive use of small plants. This means that the SWPC will select those particular allocated materials which are of great importance to small plants and will present to the War Production Board the needs of small plants for such materials. The SWPC makes it very clear that it intends to distribute the materials and equipment to all plants, not on a "programmed" basis, which means distribution to those plants specifically chosen by the judgment of other supervising officials and agencies, but to all plants "capable and desirous" of using the materials.

No Increase Permitted

OPA recently was asked to grant a price increase to cover a component made of plastics to be used in connection with a household article. The application was turned down on the basis that the 1942 price adequately covered the need.

This led to the introduction of a memorandum which has caused considerable discussion in OPA. The memorandum asserts that OPA has no policy which can be understood by plastics manufacturers in order to enable them to determine prices when producing for the present market, or when planning to produce for the postwar market. It is pointed out that, in Administrator Bowles' recent over-all declaration affecting price-making policies in connection with reconversion and postwar production, there was no reference applicable to the plastics industry. OPA apparently feels there has not yet been a reason to formulate such policy. It seems to hold the thought that postwar reconversion policies for pricing are premature until V-E Day. It is pointed out that Bowles recently stated he was ready to declare such policies 48 hours after V-E Day for an equivalent occasion. In all likelihood the problem posed by the memorandum will be submitted to the OPA Plastics Industry Advisory Committee, and Committee will be requested to define its ideas on the subject.

There have been several applications for price ceilings on heels and soles made of plastics materials. It was determined the plastics shoe heels and soles do not belong in the regular category covered by prices for leather heels and shoes, and that they cannot be classified as plastics products because they are not manufactured by molders or fabricators customarily engaged in the business. Plastics heels and soles therefore were exempted from coverage of the plastics products maximum price regulation, and, beginning Nov. 8, they were placed under the General Maximum Price Regulation which freezes prices at March, 1942, highest prices. The base date pricing period was fixed for the period of January 1, to March 31, 1942. The regulation comes under Amendment 3, to MPR 523, and the price controls will be administered by OPA's Rubber, Chemicals and Drug Price Branch. END

ENGINEERING *News Letter*

By LEWIS WINNER
Market Research Engineer

Applications . . . Methods . . . Materials

Some months ago this column discussed several types of shellac substitutes that had been developed for use in insulating compositions, spirit varnishes and particularly thermoplastics phonograph records. A few weeks ago a shellac substitute using pine wood as a basis of extraction was developed.

This project, initiated by John M. De Bell of Long Meadow, Mass. uses a substantially insoluble petroleum hydrocarbon resin derived from the wood. According to inventors the new resin when combined with suitable proportions of ethyl cellulose and a plasticizing agent, becomes soluble in alcohols, ethers and halogenated hydrocarbons, like shellac, and can be combined with several types of plasticizing agents, such as triphenyl phosphate, chlorinated naphthelene, or castor oil. Castor oil has been found particularly suitable because of its low cost and excellent plasticizing action.

Mr. De Bell reports that stump pine wood should be used in obtaining this resinous material. In preparing the wood for extraction, it is usually steamed to remove volatile constituents, such as turpentine and pine oil. Then a coal tar hydrocarbon (benzine or toluene, etc.) is used to extract the pine wood. After freeing the wood of volatile constituents, a resinous residue consisting of a mixture of wood rosin and the resin itself remains. The rosin is removed by using a petroleum hydrocarbon such as gasoline. The resinous residue that remains is low in abietic acid. Mr. De Bell reports this is one of but several methods that may be used to isolate the resin.

The resinous material, which is a dark red-brown color, has a drop melting point between 95 and 125° C.

Several types of plastics forms were prepared by Mr. De Bell during development. One of these was compression molded at a temperature of about 220 to 230° F under about 4000 psi pressure. About 4% by weight of zinc stearate was used as a mold lubricant. The resulting form had a flexural strength of about 3000 psi and an average modulus of elasticity of about 120,000 psi. Castor oil was used as a plasticizer.

Some of the mineral fillers which were found suitable were china clay as well as precipitated barium sulphate, keisel guhr, silicate powder, carbon black, marble flour, whiting, titanium dioxide and zinc oxide. Mr. De Bell states that these fillers are usually employed in amounts ranging from 30 to 60% by weight of the entire composition. He reports that the new shellac substitute will tolerate relatively high proportions of fillers. Cellulosic fillers such as cotton flock, wood flour may also be used.

Tests made with phonograph records using this new material indicate that good dimensional stability, low needle drag and good wearing qualities are available. In some instances, Mr. De Bell has used from 30 to 50% shellac with his new resin to prepare some types of phonograph records achieving extreme hardness.

Resin in Concrete

Concrete pavements with small quantities of *Vinsol* resin may become a popular item in postwar construction. Tests conducted at the U.S. Bureau of Standards indicate that cement-sand mortars made of *Vinsol* resin cements are in most cases more plastic than the mortars of untreated cements. The tensile and compressive strength of cements with this vinyl resin are very high. In the series of tests conducted, tensile strengths ranging from 195 to 465 psi

and compressive strengths from 900 to 3360 psi, were indicated.

The introduction of *Vinsol* resin also provides for an increased entrained quantity of air. Heretofore salt solutions were used to achieve this result, producing a pavement that was more resistant to scaling, freezing and thawing.

British Predictions

A report prepared by the British Plastics Federation agrees with the results of American surveys in indicating an almost limitless number of applications. The chemical resistance and hygienic qualities of plastics recommend their use in chemical works, plants and homes. The relatively low thermal conductivity of plastics, which reduces the risk of freezing, makes it ideal for many installations.

In this country experiments are being conducted with vinylidene copolymer for domestic piping, with encouraging results, indicating that it is entirely possible to use such piping for hot, cold water and even boiling water. The British also report that cold-setting phenolic resins can be used in acid tanks.

Pile driver dollies using laminated fabric plastics have proved much more enduring than wood. Resistance of the plastics to fire makes it possible to drive at a pace that might cause a wooden dolly to catch fire. Discussing structural components, the report cites the use of plastics for window frames, window boards, doors, staircases, chimney pieces, fire place embellisments, and skirting boards. The British say that the invention and development of the rubber-bag process that has been used in aircraft construction, might make it possible to produce complete staircases by molding plastics. Wood veneers or a combination of wood veneers and resin-impregnated paper might be used to provide the required strength and resistance to impact.

The report also discusses the possibilities of using plastics bricks instead of clay bricks. Such blocks might be lighter, although there is the problem of durability, a problem that will undoubtedly be solved with time.

Load-bearing structure is one knotty problem which seems to face the plastics engineer. In this sphere the British experts point out that the load behavior of thermosetting plastics and the low softening temperature of thermoplastics might introduce a building risk. However, they say, it is entirely possible to use resin-bonded plywood and laminated wood in place of wooden beams. Where plastics will be used in place of steel, it will be necessary to determine not only the density of the plastic but the strength-weight ratio that determines the saving in weight. The dimensions of the structural member must be increased so much to compensate for a lower strength of plastics that much of the advantage resulting from the lower density is lost. However, where the flexural rigidity is the more important consideration, a material of low density has an advantage, because sections can be made thicker for the same weight and the flexural rigidity increases in greater proportion. Therefore since flexural rigidity is a factor that determines the resistance to buckling of struts, compression flanges of beams and shear members, the material having the highest value of $\frac{E}{p^2}$ or $\frac{E}{p^3}$ (E being the modulus of elasticity and p the density), will be the best to use for this work. Reinforced plastics may be used to considerable advantage in such instances.

Navy Binoculars

Thermosetting phenolics, using a long-fiber asbestos filler, are extensively used in $6 \times 42''$ binoculars made for the Navy. The shortage of aluminum at the beginning of the war prompted the Army and Navy Munitions Board to initiate the development of the binoculars. The new binocular has been waterproofed for a depth of 100', is resistant to fungi, corrosion, temperature changes, severe shock and impact.

A low weight aluminum silicon alloy was selected for the metal inserts because its expansion coefficient approximated that of the phenolic. END

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to please YOU, not ourselves. We didn't buy our big batteries of molding presses because we thought they were good looking, but because we figured we'd be able to fill your orders the way you want them filled.

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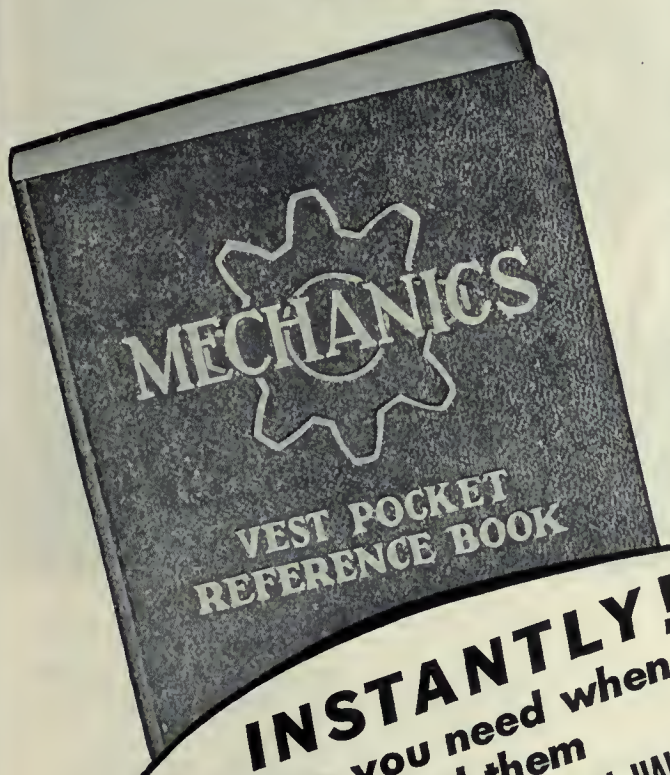

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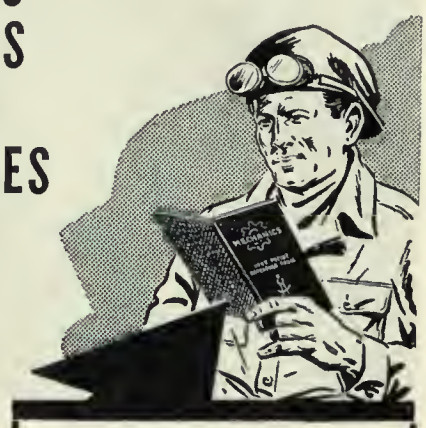

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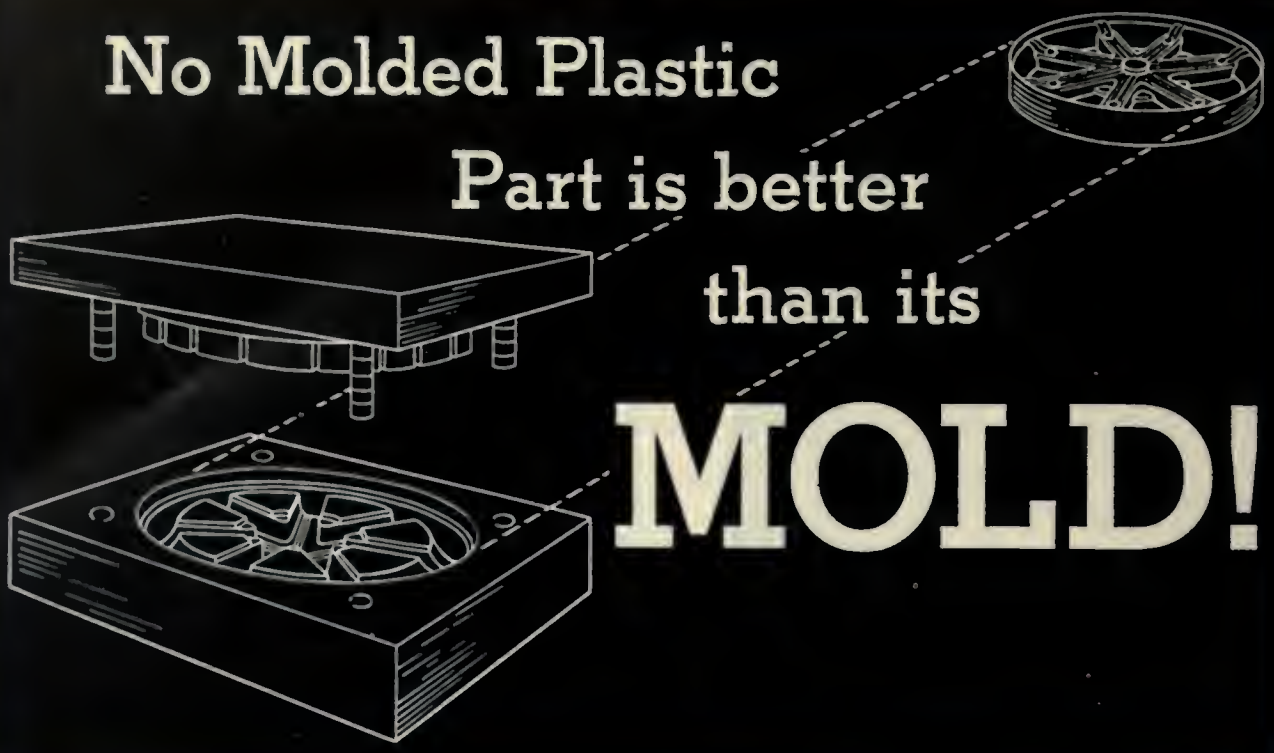

THE MOLD is the master pattern which governs the shape, dimensional accuracy, and surface finish of every part that comes out of it. Likewise, the ingenuity with which it is designed often governs the speed and economy of production. It is the most important single factor in the process of plastic molding.

That's why we put so much emphasis on mold-making . . . why we are satisfied with nothing short of perfection . . . why we maintain one of the largest and best equipped mold-making departments in the industry, manned by highly skilled and experienced craftsmen.

We know mold-making . . . and we should, for the men who founded CMPC and are its directing heads today have been designers and builders of molds for a quarter of a century.

That's a good point to bear in mind when choosing your plastic molder. And, remember, too, that CMPC offers a complete service . . . designing, engineering, mold-making, molding, and finishing . . . backed by an organization with over 25 years of experience and the largest, best equipped custom molding plant in the Middle West.

We've been at it for over 25 years

You can get action on your postwar plans . . . NOW!

If you're thinking in terms of plastics for your post-war product, ask for the services of a CMPC Development Engineer. He can be of real help to you . . . by determining what parts can be advantageously molded of plastics . . . by helping in the selection of materials . . . by putting at your disposal the latest wartime developments . . . by suggesting design for most effective and economical results . . . by making laboratory tests, building experimental molds, or building your finished production molds.

This preliminary work can be done now. Then, when priorities are lifted you'll be in line for production as soon as materials and press capacity are available. Write today. There's no obligation.

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COMPRESSION, INJECTION, AND TRANSFER MOLDING OF ALL PLASTIC MATERIALS

Please send me additional information and literature on items listed below which appeared in the _____ issue of plastics

Name
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List by Key Nos. from "What's New in Plastics" or "Literature Review":

ADVERTISED PRODUCTS (name and page)

Three-Post Hydraulic Laminating Press

William Apparatus Co., Inc.
Watertown, N. Y.

Provides improved alignment of platens, thereby avoiding unequal moldings. Equipped with a Hycon 3-phase, 220 v motor-drive for uniformly-sustained high pressure.

Capacity of the press is 50 tons, full use of which requires a 7" ram. A 5" ram produces about 30 tons at 3000 psi, with correspondingly more rapid travel. Pumping capacity of the unit is ⅝ gal of oil per minute. The press is also equipped with 110 v a-c hot plates with Fenwal thermostat control or steam-heated plates for steam, hot or cold water. Platen size is 12 x 12". Construction material used is semi-steel casting. By means of synchronized hand handwheels, 5" of rapidly adjustable plate opening is available.....(132)

Versatile Punch Press

Reimuller Brothers Co.
Franklin Park, Ill.

Can also be used as a pipe vise, tensile or compression and tensile testing machine or a shear for plate or rounds, or die-set in small plastics forming work.

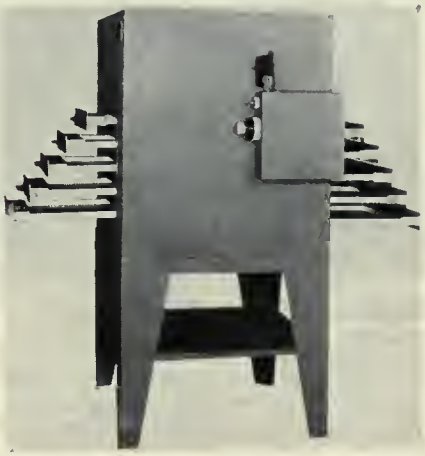
Combining the features of the "V" way vise and the gap style press manufactured by the same firm, the unit is a new precision bench press of semi-steel construction. Further uses to which the unit can be adapted are marking, notching, riveting, crimping, mounting samples, etc.

Incorporating "V" ways to eliminate the use of die shoes, the new press is designed for a more speedy and efficient handling of many production jobs. It is made in one size, 5 ton, and has a 5 x 6" platen with 7" of ram movement.

Only two levers are used in the hydraulic foot control, one to apply pressure up to the rated tonnage; the other for release which has a two speed return. No outside air lines or power is needed and unit is self air eliminating. Operator's hands are free when operating.....(133)

Plastics Pre-Heating Oven

Despatch Oven Co.
Minneapolis, Minn.



Double-end unit designed originally for phonograph manufacturers. Purposely built narrow in order to fit easily between presses, the oven has 12 sliding drawers, six of which pull out of one end and six from the other, permitting two operators to use the same oven at the same time without interfering with each other.

The unit can preheat preforms such as are used in commercial molding plants. It is electrically heated, has forced-air circulation to insure uniformity of temperature within 4° F in all sections of the chamber, and has a stand to bring the oven to proper working level.....(134)

Non-slip Flooring

Miracle Adhesives Corp.
Newark, N. J.

Non-slip plastics floor coating which may be put down over old wood, concrete or steel floors. Designed to meet the need for an absolutely foolproof-fireproof-slipproof coating for gun platforms, stair tread, engine room floors, and many other areas on ships, tanks, etc.; for floors of gliders, for step plates on planes carrying parachute troops, and for ramps and other areas such as wing walks, etc., this material was released a few months ago for civilian use and installations have been made in such plants as foundries, oil plants, dairies, bakeries, on trains, trolleys, busses, on stairways, ramps, residence steps, cellar floors.

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In rapidly-moving times such as these, keeping up with every latest development in one's field is a "must." War's insatiable demand for swifter production, and the competitive drive toward lower manufacturing costs require that all avenues leading to a solution of these problems be explored thoroughly.

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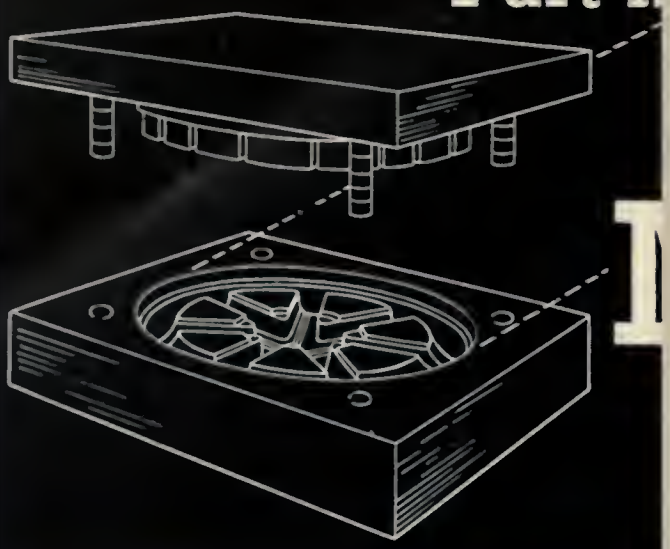

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1031 N. Kolmar Ave. Chicago 51, Illinois

COMPRESSION, INJECTION, AND TRANSFER MOLDING OF ALL PLASTIC MATERIALS

WHAT'S *New* IN PLASTICS

Dyes Finished Products

Wilmington Chemical Corp.
New York, N. Y.

New cold-dip dyes, with which finished plastics products of any size or shape may be colored permanently.

Marketed under the trade name *Poly-tint,* the dyes will prove a boon to plastics manufacturers who heretofore found it necessary to purchase colored molding powders for each color required. Any ordinary dipping kettle or tank may be used. The dye is employed just as it is removed from the container. Nothing is added; no heat is required. The finished, polished product is immersed in the dye until the desired shade is obtained. It is then removed, rinsed in clear cold water, dried, and packed for shipment.

When standard colored molding powders are used it is necessary, at the end of each run, to shut down all machinery while the machines are cleaned in preparation for the next run of a different color. By permitting continuous operation of all machines on one transparent, translucent or opaque base material, such expensive shut-downs can be avoided. The dye may also be employed as part of a continuous operation merely by arranging the dipping tank at the end of the production line so that coloration becomes the last manufacturing operation. At the present time, the dye can be applied to the following plastics: methyl methacrylate, cellulose acetate, cellulose acetate butyrate, and ethyl cellulose. .....(131)

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William Apparatus Co., Inc.
Watertown, N. Y.

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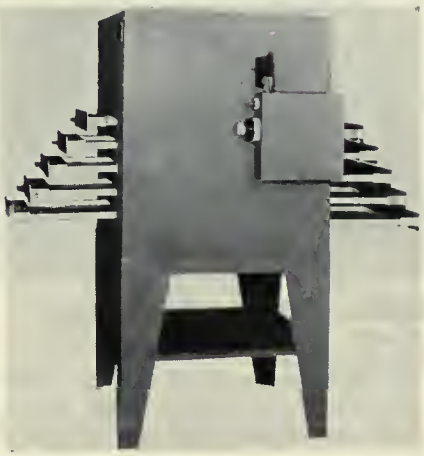

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Compact Circuit Breaker

Westinghouse Electric and Mfg. Co.
E. Pittsburgh, Pa.

A new 100-amp *De-ion* circuit breaker which requires less space and permits lighter structures for distribution panelboards, built-in applications and bus duct plug-ins. Equipment of this type is used on electronic heating units.

All ratings are available in one compact breaker with uniform pole spacings and terminal arrangement, providing complete interchangeability between ratings. The new F Frame permits for the first time a 100-amp, 600-v a-c or 250-v d-c breaker in the same space formerly required by the 50-amp, 600-v a-c or 250-v d-c rating.....(136)

Inhibits Wool Shrinkage

American Cyanamid Co.
New York, N. Y.

A shrinkage control method for wool which retains the original appearance of the fabric and protects it against repeated laundering and dry-cleaning is provided by a new synthetic resin manufactured by American Cyanamid Co. and trade marked under the name *Lanaset*.

Lanaset, a melamine resin, has already been tested with success by a number of leading mills and finishers. It stabilizes wool and wool-blends without affecting their absorbency and other normal characteristics. Traditional chemical methods for controlling shrinkage actually alter the wool and destroy some of its valuable properties.

Lanaset also reduces felting, and prevents pilling and fuzzing, provides a much higher resistance to alkali than untreated wool possesses.

The fabric is passed through an aqueous bath containing the resin, and squeezed uniformly through a mangle, dried and heat cured. Washing removes surface resins.....(137)

X-ray Spectrometer

North American Philips Co.
New York, N. Y.

A Geiger-counter X-ray spectrometer, the latest addition to the *Norelco* line of industrial X-ray equipment.

The unit provides an extremely accurate method for measuring distribution and intensities of X-ray reflections. For certain applications, it has some advantage over conventional diffraction procedure which entails exposure and development of film besides measurements and computations. The spectrometer provides a rapid method for directly determining location and intensity of diffracted rays. Quantitative analyses of mixtures can be obtained in a matter of minutes. X-ray diffraction analysis has almost unlimited fields of application in chemical and metallurgical industry.....(138)

PLASTIC MOLDING

With the Stamp of Individuality

You've heard it said that "Every business is but the lengthened shadow of one man." That is of particular importance in your choice of a molder for that vital product of yours.

You'll recognize that molded plastics by MARTINDELL bear the unmistakable stamp and seal of a master craftsman—a man who knows the business "from A to Z."

In plastic molding *experience* is the priceless asset. You may submit your samples or blueprints to us with complete confidence that they will receive a careful appraisal, and if plastics is the logical material, you may safely leave the completion of your order in our hands.

MARTINDELL MOLDING CO.

OLDEN and 6th Street • TRENTON, NEW JERSEY

Literature Review

Chemaco Polystyrene

Chemaco Corp.
Berkeley Heights, N. J.

Presents full data concerning the company's new polystyrene molding material for injection and extrusion. The material can also be compression molded.

Chemaco polystyrene is available in an unlimited range of colors from a brilliant, water-clear crystal to the darkest opaques; has a specific gravity of only 1.05; and is marked by negligible water absorption. Dimensional stability is described as extraordinary.

Possible uses extend throughout the architectural, automotive, aircraft, electrical, medical, chemical, radio and communications, refrigeration, container, dispenser, novelty, optical, and premium fields. .....(139)

Bonding Elastomeric Resins

Carbide & Carbon Chemicals Corp.
New York, N. Y.

A summary of standard methods for bonding *Vinylite* resin compounds. Also contained in the 16-page booklet are a general study of the adhesive materials employed, and details of formulae and methods for bonding *Vinylite* plasticized sheeting to itself, to metal, ceramic surfaces, leather, wood, concrete, wallboard, cloth and miscellaneous materials.....(140)

Plastic Protective Clothing

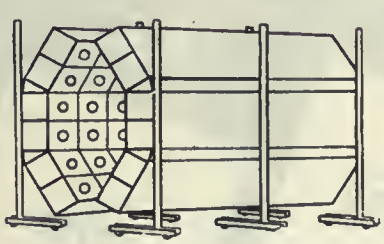
Resistoflex Corp.
Belleville, N. J.

A 16-page, two-color catalog on *Featherweight* and heavy duty protective garments made by the company from its solvent-proof transparent plastic, *Compar*. The clothing, which protects workers whose duties bring them in contact with grease, oil, organic solvents, gas fumes or dust, include gloves, cap with attachable snood, tie-around head kerchief, *Featherweight* sleeveless apron, *Featherweight* smock, transparent and lined sleeve guards, and compounds to make shoes impervious to oils and solvents. All the items are impervious to organic solvents, afford protection against dermatitis and folliculitis, oil, grease and dust.

The catalog also includes a section on cleaning, maintenance and repair of Resistoflex garments .....(141)

Infra-Red Equipment

Fostoria Pressed Steel Corp.,
Fostoria, O.



A brochure displaying the new designs in *Evenray* equipment which the company developed to insure economical utilization of infrared energy in drying, baking, preheating and dehydrating processes.

The accompanying drawing shows the floor-type installation, stationary or portable. All units produced by the firm are described as featuring wide flexibility of tunnel contours, adaptability to all production line needs, low-cost maintenance, channel-enclosed wiring, accommodation for wide range of source sizes and wattages, maximum reflection of rays, shielding of work from drafts, dust and glare. *Evenray* systems may be suspended from the ceiling or wall. .....(142)

The Genius to Create
The Skill to Produce

The ability to create designs that are practical as well as artistic and distinctive has given the House of Plastics leadership in its special field.

Complementing the versatility of its creative genius the House of Plastics, through its highly trained organization, is noted for its unusual skill and capacity for transmitting design into production on a volume basis.

The keynote throughout is high quality and unique conception. This is exemplified in a wide array of finished articles including display and store fixtures, furniture specialties for home and office, cosmetic containers, decorative items and miscellaneous art objects—in addition to many new industrial applications which are now being planned by us for postwar uses of an imposing list of clients.

If you are interested in investigating the possibilities of fabricated plastics as applied to a special production problem of yours, please feel free to write us. We'll be glad to give you the benefit of our experience and suggestions without obligation.

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PLASTIC MOLDING
by D. A. Dearle.

A good basic handbook for persons desiring to make a systematic study of the problems of molding and plant management, this volume covers not only the techniques of compression, injection and other types of molding, but also gives the solution to many production and managerial problems encountered in the industry.

Among these are die design, cost control and accounting, selecting the proper materials for certain applications, custom and proprietary molds and future applications in building construction, furniture, automotive industry and aeronautics. Heatronic molding and jet molding are evaluated.

Of particular interest is the chapter entitled "Questions and Answers," in which numerous miscellaneous problems are taken up; for example: "Can changes in design be made after a production mold is completed?" "Is it possible to mold dissimilar parts in the same compression mold?" and "When threaded sections are included in a design of a molded piece, are there any distinct benefits to be derived in using inserts, or is it just as advantageous to have the threaded part incorporated in the mold?"

Clear, simplified wording distinguishes this book from many written in technical fields.—*Chemical Publishing Co., Inc., Brooklyn, N. Y. 196 pages, $3.50.*

SYMPOSIUM ON PLASTICS
by the American Society for Testing Materials.

Sixteen technical papers prepared by outstanding authorities provide, in this condensed form, extensive data on important problems in the field of plastics. A special section entitled "Summary of Properties, Uses, and Salient Features of Families of Plastics" gives interesting and authoritative information on their applications and properties.

The symposium was arranged by the Philadelphia District Committee, ASTM, and the papers were carefully reviewed and edited by leaders in plastics technology. In the first section topics covered include heat resistance of laminated plastics, effect of environmental conditions on the mechanical properties of organic plastics, diffusion of water through plastics, stiffness and brittleness properties of nonrigid vinyl chloride-acetate resin compounds, and then follow extensive contributions covering behavior of plastics under repeated stress, and testing in connection with the development of strong plastics for aircraft.—*200 pages. Blue cloth binding, $2; heavy paper cover, $1.75.*

•

MODERN WOOD ADHESIVES
by T. D. Perry.

It is significant that the author apologizes in the preface for seeming to have given exceptional emphasis to the synthetic resin adhesives. This, he explains, is due to the fact that "the acknowledged importance of this group of adhesives gives a substantial and adequate background to such a position."

Illustrations and specific technical data are profuse, and every effort is made to define and clarify all terminology employed in the field. Considerable space is devoted to the rubber-bag molding techniques.

Chapter headings include "Methods of Comparing Glues," "Glue Mixing and Spreading Equipment," "Pressure in Gluing," "Adhesion Secured by Heat," "Redriers for Glue Solvents," "Impregnation," and "Glue Testing."—*Pitman Publishing Corp., New York. N. Y., 208 pages, $3.*

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HIGH TENSILE STRENGTH
HIGH DIELECTRIC VALUE

Of especial interest for the molding of electrical appliances, insulators, knobs, panels, sockets, etc.

Attractive Natural Color, Golden Brown 50% — Increase in All Strength Factors—Obtained in Laminated and Filled Forms

CIBA PRODUCTS CORPORATION, 77 RIVER ST., HOBOKEN, N. J.

association activities

Exhibits Feature SPI Fall Conference

Displays of hundreds of plastics items that have contributed to the superiority of Allied arms and equipment were an outstanding element of the SPI Fall Conference held at the Waldorf-Astoria Hotel, New York, Nov. 13-14.

Characterized by an emphasis on group meetings, the conference offered each branch of the industry to discuss its special problems. Sessions were held by the button manufacturers, extruders, injection molders, compression molders, fabricators and machinery producers.

On the day preceding the conference a forum on plastics in the building field was held by the Technical Committee of the New York chapter, American Institute of Architects with the SPI at the hotel, with George K. Scribner, president of the SPI and the Boonton Molding Co., presiding.

St. Louis SPE

At the recent St. Louis SPE meeting held in the Forest Park hotel, C. F. Marschner, manager Plastics Division, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., spoke on "Production and Standards for High Strength Paper Base Laminates," illustrating his subject with slides.

Mr. Marschner brought out the possibilities of the large size one-piece paper-base laminates that are possible through low-pressure molding.

Chicago ASME

"Choosing the Plastic Material" was the title of a talk given by William O. Black, chief chemist, Chicago Molded Products Co., at a recent meeting of the ASME, Chicago section, accompanied by a sound motion picture, "This Plastic Age."

Textile-Resin Committee

The ASME subcommittee on dyeing, bleaching and finishing (D-13) has formed a committee on the identification of resin finishes for textiles, headed by Frank Brennan of the United States Testing Co. Other members are J. Edward Lynn, American Cyanamid Co.; James A. Stevenson, Bradford Dyeing Association; Dr. Edwin C. Dreby, Scholler Bros.; Earl D. McLeod, Arnold Hoffman & Co.; Elmer H. Rossin, Monsanto Chemical Co.; Ens. John H. Merscher, Naval Clothing Depot, Brooklyn; J. H. Carlitz, Industrial By-Products Research Co.; and J. Phragmen, United Merchants & Manufacturers Management Corp.

SPE Secretary-Treasurer

L. S. Shaw, Plastic Industries, has been named secretary and treasurer of the SPE, succeeding John H. Deere of Santay Corp., Chicago, who resigned. Mr. Shaw, also president of the SPE's Cleveland chapter, automatically becomes a member of the National Board of Directors. His appointment changes the location of SPE national headquarters from Chicago to 3262 Lansmere Rd., Cleveland 22, O.

New ASTE Office

The ASTE has established its national office in the Penobscot Building, Detroit 26, Mich. The consistent growth of the society since its founding in 1932, until it now numbers more than 16,000 tool engineers, has resulted in the expansion of facilities necessitating the change.

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INDUSTRY HIGHLIGHTS

Plastics Star at Packaging Show

The importance of plastics in the field of packaging was brought home to the more than 800 members of the Packaging Institute attending its annual conference in New York on Nov. 1-2, when no fewer than five of the 13 papers formally presented there dealt with plastics films, coatings, laminations and closures.

One of the outstanding talks given was that by George K. Scribner, president of the SPI and the Boonton Molding Co., on a new method for testing the strength of molded closures. Excerpts from his paper follow:

"The regular method of testing cap enclosures duplicates the application of the cap to the bottle and merely involves screwing it tighter and tighter until the cap breaks. The torque applied at the time of break is either measured directly in inch pounds or set up on a comparative index.

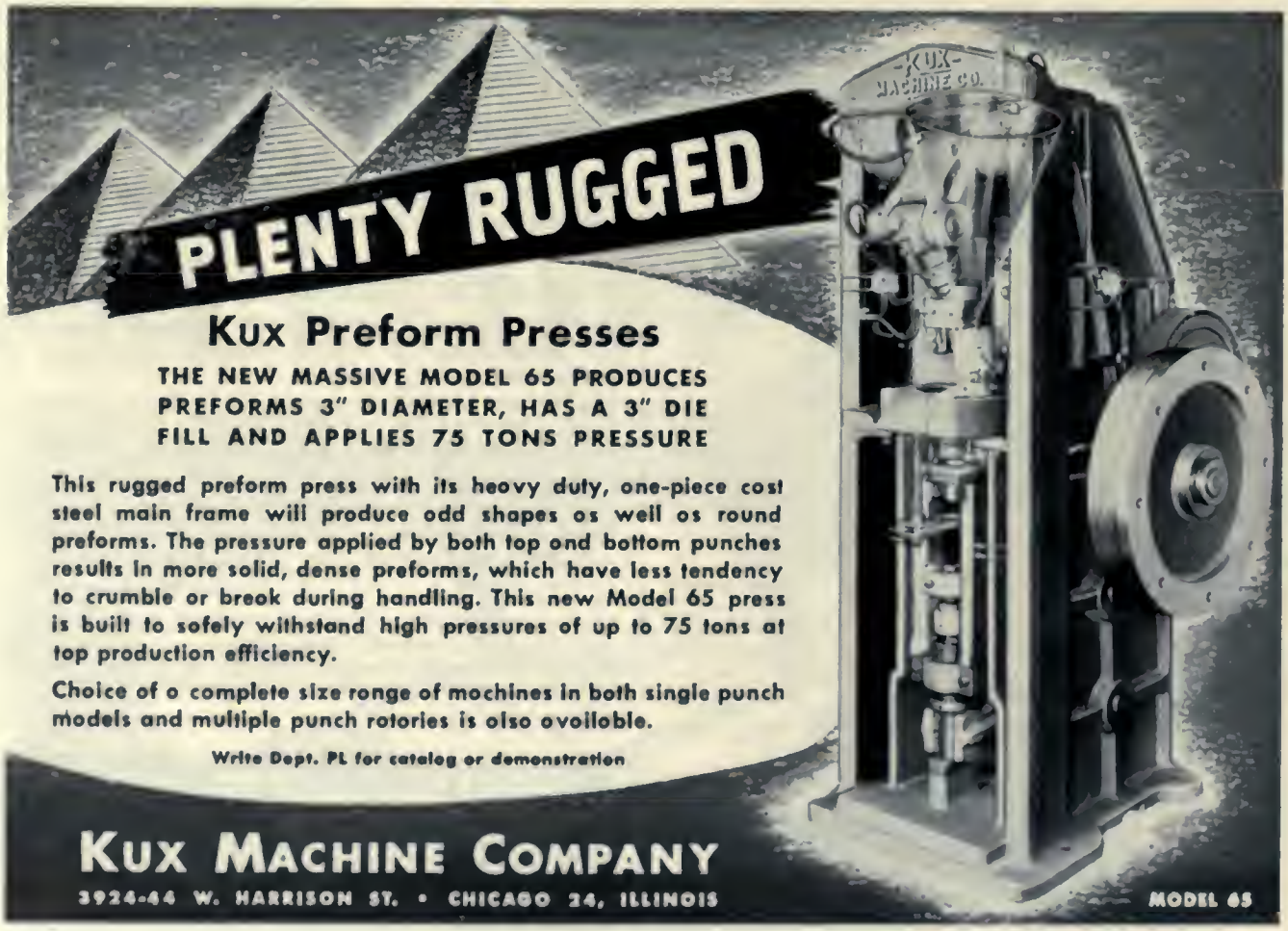
"The apparatus we have used for this purpose is simply a steel pin, which duplicates the bottle thread, a chuck to engage the outside of the cap, and a hand wheel attached through a torsion device to the chuck. As the hand wheel is turned, the cap is tightened on the pin and a small indicator shows the amount of pressure applied. The point at which the indicator stopped necessarily indicated the strength of the cap, at least on an index if not absolutely.

"This would seem to be a perfectly fair way of testing the caps until you realize one thing. The reason the cap breaks is because the thread of the cap is sliding down on the thread of the glass with a result very much like a wedge being driven between the top of the cap and the side walls of it, tending to tear the top off. The difficulty arises when the wedge has grease on it, for it will then translate an infinitely greater proportion of the applied torsion to the strain factor that tends to break the cap.

"If, on the other hand, the surface of the thread in the cap or the surface of the thread in the glass were rough, a great deal of that applied force would be eaten up in friction between these two parts, and the strain would be proportionately less.

"This means that if an inspector happens to put his hand on the steel pin on which the cap is threaded for the test enough grease would be taken off his hand to lower the apparent strength of the cap, as indicated on the torsion tester, as much as 50%."

After experimenting for a few years, he added, the company finally decided that torque testing machines did not actually simulate the pressure of the contents of the bottle. The natural way to do this was a pivoted lever, like an ordinary bar scale, on which he could move out a weight, and as it moved out a measurable pressure would be exerted on the inside surface of the cap. This worked very well and he was able to set up a scale of values which would not be affected by the condition of the pin on which the cap was screwed. "This," he declared, "took away



from the question of the strength of the cap any question of the irregularities involved in the bottle, because we felt we had a right to assume that the cap must have certain intrinsic strength regardless of such irregularities.

"We have found out a few things that are very helpful in chasing down breakage complaints. We know definitely that there is a band of caps, say from 400 index up, which will work satisfactorily on even the fastest machines; that from 350 to 400 the cap will be amply strong to operate on the 90 per min machines but there will be a breakage of about 3% on the 120 per min machines. Then there is a band from 300 to 350 which practically cannot be broken by hand at any time. The fact that the cap will break on the fast machine is due to the extreme difficulty of overcoming the inertia of the rapidly revolving chuck at such high speeds.

"The molded closure has so conclusively proved its ability over the years to dress up a package and present it in an appealing way to the public that it is certainly here to stay, in spite of the relative difference in cost between it and the metal closure. This difference in cost may look to be pretty big when you consider a million caps but it is very small when you consider the cost per package. A third of a cent is certainly not much on a bottle of wine or whiskey which sells for anything from $1 up to $6 or $7, but two bottles, one with a molded closure and one with a metal closure, placed side by side, will soon demonstrate which one will be sold off the shelves first."

Saran and *Geon* coatings and films were discussed, respectively, by Frank J. MacRae, Plastics Development Division, Dow Chemical Co. and M. S. Moulton, technical service engineer, Chemical Division, The B. F. Goodrich Co.

Karl E. Prindle, director of product development, The Dobeckman Co. discussed papers laminated with hot melt adhesives, modified wax laminated cellophane, and aluminum foil with heat sealing coating on the inside and laminated with cellulose acetate on the outside.

"Modified Wax Coatings, Synthetics and Blends" was the subject of a talk by M. T. Rogers, manager, Packaging Division, Dewey & Almy Chemical Co. Mr. Rogers said there was need for better bag laminating materials, and predicted an important role for protective coatings of various kinds of papers as well as for coatings applied to cartons after they have been packed.

Success of Beetle cements in the famous DeHavilland *Mosquito* plastics-plywood bomber points the way to many new possibilities in the woodworking fields, according to the manufacturer of the cements, American Cyanamic Co., New York. Composite structures, assembled with safety, econ-

In assembling the sealing door of a bulkhead in the fuselage of the DeHavilland "Mosquito" bomber, "Beetle" cement, developed especially for wooden aircraft, is applied to the top surface of the rib-like form before the skin surface is added

HOW AGA MOLDED

Plastic Lenses

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At even remote temporary air bases, the AAF pilot is now guided to his three point landing by ingenious signalling provided through AGA tri-color lenses. This new plastic lens development makes effective use of color—separated, directional light beam—guiding lights to keep our airborne fighters always on the beam to safe landings.

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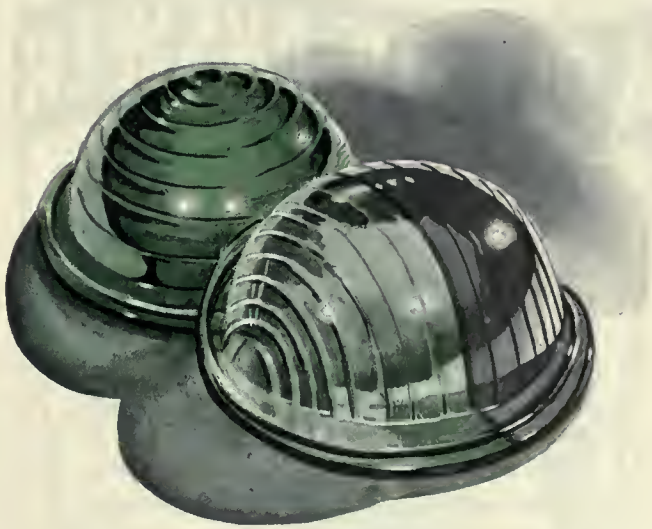

Imagine what these new features can mean to your peacetime product:

Higher light transmission . . . greater strength . . . 50% lighter weight . . . unlimited color range . . . multi-colored lenses . . . sharply controlled directional lighting.

No matter what your use of lighting or transparencies, these are good reasons why AGA's method of molding craftsmanship points the way to peacetime product advance.

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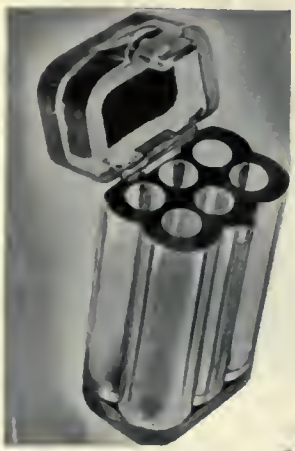
Addison

PRECISION injection molding achieved in this plastic detonator cap container:



Perfect closure, with correct tension to prevent accidental opening.
Exact dimension and depth gauge
Transparency
Waterproof, Shock-proof and Warp-proof qualities

KIRK engineering, from design to final injection molding, has accomplished a hitherto well-nigh impossible feat. Detonator cap containers are vital equipment—and this practically indestructible plastic container is a time-saver, a trouble-saver, a *life*-saver . . . produced by KIRK many, many times faster than now out-dated containers of other materials were made. Perhaps KIRK Plastic Engineering can help you solve your production problem . . . write us . . . no obligation.

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TO YOUR PROBLEM

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only and speed, can be built which are, weight for weight, stronger than steel.

Beetle cements are cold-setting urea resin adhesives particularly suited to assembling gluing where complex shapes prohibit perfect joining and where high pressures are not applicable to insure uniformly thin glue lines. They also fill gaps and slight variations occurring in wood, and are unaffected by exposure to severe weather conditions.

Beetle cements differ from other urea formaldehyde resins in that they are said to eliminate crazing. Unlike casein, vegetable and animal glues, which attain bonding strength by loss of water to the wood and the air, these cements set by polymerization, requiring a certain amount of water throughout the reaction, thus making it advisable to use wood which is not too dry.

●

OPA now permits producers of synthetic resins containing more than 50% gum rosin to apply for price increases if they cannot maintain production at present ceilings. Polyethylene, relatively restricted to military use, has been placed under control of M-300. Small order exemption for experimental use has been raised from 5 to 25 pounds. Announcing reduction of small order exemption from 10,000 to 2,000 pounds, WPB predicted there would be drastic reductions in the use of urea and melamine resins for civilian products. Adipic acid, used for nylons, plasticizers, insulating resins, and sealing compounds for gasoline tanks, has been allocated virtually exclusively for military requirements, and has been transferred to Order M-300. Phthalic alkyd resins have been placed under M-300, which is expected to expedite deliveries of these materials for military uses.

●

A new resinous coating known as allyl starch, which has extreme resistance to organic solvents, acids, alkalies and other corrosive agents, heat, gasoline, oil, acetone and other liquids, has been developed by the U. S. Department of Agriculture, Bureau of Agricultural and Industrial Chemistry, Eastern Regional Laboratory, Philadelphia.

Developed from sugars and starches of farm crops, and used for textile coatings, the material is easily applied, is transparent, has a high gloss, a hard surface and high flexibility. It is produced by treating starch with allyl chloride or allyl bromide.

●

Union Carbide and Carbon Corp. announces formation of a Plastics Group which brings together many activities of the firm that are related either to the manufacture, compounding or sale of synthetic resins and plastic products. This step has been taken to co-ordinate the technical knowledge, sales engineering, research, production and distribution methods for all plastics and resinous products.

Bakelite Corp. will carry on the integrated sales activities of the new group.

●

Michigan Molded Plastics, Inc., custom molders, have opened several new field and branch offices, as follows: Detroit, Mich., James T. Libbey; Moline, Ill., L. R. Christiansen; Dayton, O., W. E. Campbell; Kansas City, Mo., E. W. McGrade; and Buffalo, N. Y., Charles Larkin II.

●

The OPA plans to undertake a study of the costs of plastics and impregnated woods in comparison with standard materials, in accordance with a recommendation made by its Commercial and Public Wooden Furniture Industry Advisory Committee.

●

The U. S. Forest Laboratory, Madison, Wis., has developed a plastic made from laminated Alder wood. The material has great density, weighing nearly half again as much as water, and is described as warp-proof and practically fireproof. The board can be sawed, drilled and threaded; will take any color of dye successfully, and can be given a smooth finish, high polish and great strength by treating the two outer layers with phenol resins. The Alder plastics has resisted as much as 40,000 v.

PEOPLE

Lyle M. Geiger, former acting director of research, has been appointed director of research for The Neville Co. His work in the company has been in synthetic resins, solvents and oils used in various grades of rubber and rubber products, as well as in broadening the application of the *Nevillac* resins and plasticizing oils.

Lyle M. Geiger

G. W. Whitehead

J. E. Trainer

J. E. Trainer, vice-president in charge of production at the Firestone Tire and Rubber Co., has received an Army Ordnance citation for distinguished service. This award is a result of his work as assistant chairman of the Intermediate Caliber Anti-Aircraft Carriage Industry Integrating Committee since January, 1943.

•

George W. Whitehead, a member of the Thermoplastic Sub-Committee, SPI and American Chemical Society, will serve in a sales-engineering capacity for the Plastic Molding Machinery Division of Improved Paper Machinery Corp.

He was previously connected with the Hercules Powder Co. and the Monsanto Chemical Co.

•

W. W. Greenway

William W. Greenway has been appointed production engineer for Mt. Vernon Car Mfg. Co. and J. P. Devine Mfg. Co., Divisions of H. K. Porter Co., Inc. Mr. Greenway was formerly a production specialist for the Austin Western Co.

•

Morris Louis Ullman has resigned as chief of Industrial Section, Los Angeles district, Office of Price Administration. Previously a plastics specialist of the OPA in Washington, he is now opening offices for consultation on government regulations in Los Angeles.

•

Jack Braden, Dayton, O., formerly chemical and production engineer of the Dayton Manufacturing Co., has joined the sales staff of Celanese Celluloid Corp., plastics division of Celanese Corporation of America. He has taken over the Dayton sales territory in addition to acting as special representative of the company at Wright Field headquarters of the Army Air Forces.

•

Willis Ahlborn Kropp has been named industrial design engineer and stylist for the Aircraft Parts Development Corp., Summit, N. J., with a view toward developing the company's post-war plant for expansion into many fields other than aviation, including plastics. Mr. Kropp has designed numerous nationally-known industrial and consumer products in diversified fields, and has been cited for outstanding utilization of mass-production and cost-saving methods.

W. A. Kropp

NU-WAY MACHINING

★ One of the many plastic parts that can be finished by the HAMMOND Nu-Way machining method. *Plastic Motor Housing* for *Vacuum Cleaners* require finishing operation on bottom edge of the outside rim.

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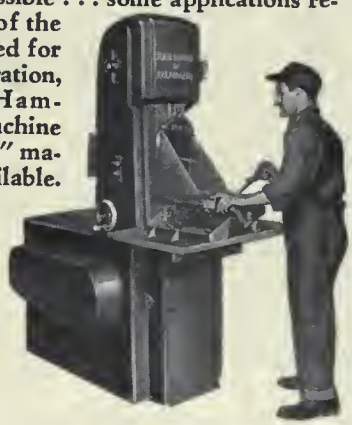
10" Wet-n-Dri ABRASIVE BELT GRINDER

You'll know what *better finishing, higher production,* and *lower costs* really mean after you have employed this NU-WAY machining method using abrasive belts. Hammond's 10" Wet-n-Dri Grinder handles wide variety of parts—10" width belt permits increased range in the finishing of larger pieces. Many production increases possible . . . some applications require only 25% of the time formerly used for finishing. Illustration, lower right, Hammond's 10" machine —other 4" and 6" machines also available.



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PASSAIC, N. J.

PROBLEMS in *plastics*

Problems and questions may be submitted to this department for answering by the technical editors or specialists in the industry.

Are any manufacturers of plastics insect screening supplying civilian needs? D. S., New York City, N. Y.

No, all plastics screening is restricted for government use at this time.

* * *

Where can I obtain information on how to manufacture novelties, toys, etc., out of plastics? R. A. P., Philadelphia, Pa.

It is most desiroble that you contact a professional plastics consultant. There undoubtedly is one in your city.

* * *

Will you kindly advise us of a source of supply for gluing satin linings to plastics? S. F., Chicopee, Mass.

The E. I. du Pont de Nemours Company, Inc., Arlington, New Jersey, has o cement which would serve your purpose.

* * *

What concern can tell me where I can obtain a transparent plastics disc 15 inches in diameter which could withstand the heat of a 500 watt lamp? W. F. O., Philadelphia, Pa.

Industrial Arts, Inc., 660 West Grand Avenue, Chicago, can supply this disc.

* * *

We are interested in a turning machine that would turn buttons automatically from casein rods. Where can we locate manufacturers of such machinery? E. N., New York, N. Y.

The Pratt & Whitney Division, Niles-Bemont-Pond Co., Charter Oak Blvd., West Hortford, Conn., manufactures these machines.

* * *

It is rumored that someone in the plastics field is planning to manufacture beverage cases. Have you heard anything about this? The theory has been advanced that such a case can never compete in cost with a reinforced wooden case. H. K., Los Angeles, Calif.

If such o cose was being contemploted, we believe it would be unoble to compete in cost with the reinforced wooden case.

* * *

Could any soft wood be treated so it could be given absolutely water resistant (by lying continually in water) qualities and yet be light enough to float? F. J. K., Owatonna, Minn.

No wood can be made to meet these requirements, that is, within the limits of modern knowledge. It con be made water-resistont, but not entirely water repellent.

* * *

Is there a solvent, which won't discolor, for putting steel insert into marblette? Ordinary cement will not dry. J. E. McA., Chicago, Ill.

Yes. The Bokelite Company of New York City can supply you with the cement.

The Coumarone-Indene Resins

(*Continued from page 77*)

Coumarone-indene resin is soluble in such organic solvents as:

Benzol, Coal tar oils, Ethyl and butyl cellosolve, Carbon tetrachloride, Ethyl, butyl and amyl acetates, Cyclohexanone, Toluol, Acetone, Xylol, Vegetable oils, Carbon disulfide, Chloroform, Dioxan

Coumarone-indene resin is insoluble in:

Methanol, Glycerine, Methyl cellosolve, Ethanol, Triethanolamine, Water, Ethylene glycol

Coumarone-indene is soluble in the following oils:

China wood, Corn, Cottonseed, Soya bean, Neatsfoot, Rapeseed, Linseed

Often in preparing molded articles and kindred material it is desirable to use various oils. When so doing it is advisable to first melt the resin in hot oil. Another preferred method is to add a solvent which will dissolve all ingredients at once. This method is particularly used by varnish makers.

Coumarone-indenes are attractive from a molding standpoint because of the good electrical qualities, corrosive resistance, mobility and gloss imparting qualities. In addition, this resin permits a wide selection of colors due to a relatively low tinting power. It is almost always combined with other additive compounds to improve the toughness and to facilitate the incorporation of fillers. The largest use in this respect is undoubtedly mastic tile and "plastics" tile.

Early bituminous flooring and tile compositions were manufactured from plastics masses which could be puddled (or worked), taking advantage of a dense solution of asphaltum as a binder. The filler was usually asbestos fiber with some whiting, slate flour, and various types of pigments. This plastics mass was applied with an implement and subsequently allowed to dry and "air-harden". As time went on, however, demands were pressed for lighter colors, as the colors available were dark and unpleasant. Consequently, many of the bitumens were replaced by coumarone-indenes.

TABLE I—Grades of Coumarone Resins

(Courtesy of The Barrett Co. and The Neville Co.)

GRADES

Neville Resin**	Cumar	Melting Point (°C)	Form
R-1 to R-6	W1/2 to W3 1/2	150-160	Flake or Solid
R-9 to R-12	V1/2 to V3 1/2	127-142	Flake
R-13 to R-16	MH1/2 to MH4	110-127	Flake
R-16A	MH9	110-125	Solid
R-17	RH	77-95	Solid
R-19	MS	55-77	Solid
R-21	RS	45-55	Solid
R-26 to R-29	P10 to P90	(As required) 10-90	Liquid to Solid

DARK GRADES

Paradene**	Cumar*		
No. 33	AX	20-35	Liquid
No. 34	BX	35-45	Semi-Solid
No. 35	CX	45-75	Solid
No. 1	DX	75-95	Solid
No. 2	EX	100-125	Solid
No. 3	FX	125-135	Solid

*Trade name of The Barrett Co. **Trade name of The Neville Co.

Headquarters—

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TRANSPARENT PLASTICS STUDY MODEL

This transparent plastics study model housing for a relay contactor is mounted next to an actual steel unit for comparison. Transparent study models eliminate explanations and tell the INSIDE STORY without words or discussion.

INJECTION - COMPRESSION TRANSFER MOLDS

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MODELS and PARTS IN ALL METALS and PLASTICS
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TABLE 2: Characteristics of "Cumar" (Hard Grades)
(Courtesy, The Barrett Co.)

Neutral	Optically inactive
Water Proof	Resistant to acids
Sp.Gr. 1.08	alkalis
High dielectric constant	brine
High electrical breakdown	oxidation
Durable to weather	heat

Non saponifiable

Today the average of binder used is 30%. A mixture of filler and binder are well masticated on hot mixing rolls, and when rolled pass to sheeting rolls while still hot; there the rolled mass is cut into the required dimensions. The final operation consists of producing certain specified polishes. The quality of the material is contingent upon the technique used plus the kinds of raw materials. In this process the selection of colors is limited, and does not permit the manufacture of light pastel shades.

To overcome such limitations, coumarone-indene is plasticized with selected various organic pitches and resins and/or oils. It is a prime requisite to pay particular attention to details for high quality.

Another popular application of this versatile plastics is commutator brushes and other molded electrical conducting carbons. The carbon is intimately mixed with the resin, cast in the required forms, and baked at first low, then high temperatures; this serves to volatize any resin surplus present, and leaves a bonded conductor with structure intact. Similarly, some molded electrical insulation articles are prepared from asbestos pulp and a solution of coumarone-indene with china wood oil in benzol and baked. In some instances preforms are used with a final hot molding and baking. Another related use is as a bond for abrasive wheel compounds.

Transcription record molders and users should be interested in the coumarone-indenes. The resin is added as a flux in any desired proportion, which improves the milling, flowing and fidelity.

Users of phenolics will be interested to learn that the addition of the resin under consideration to their compounds increases both plasticity and flow. The addition may consist of plain coumarone-indene or in combination with china wood oil. This has proven to be a valuable property in itself and usually small additive percentages suffice. Laminators and molders of high frequency products can benefit by such additions.

Neville coumarone-indene resins have replaced and extended critical resins and rubbers in the production of industrial and surgical adhesives, and adhesives for tape and the sealing of military containers. Resins and plasticizing oils have been supplied for camouflage nets and special paints for waterproof and flameproof coatings for tents, jeeps, tarpaulins, duck coverings and ordnance wrap for overseas shipments, and for adhesives for tank periscopes, tank turret seals, shoes and bazooka parts. They are also used to coat tin cans.

The character of *Neville Resins* renders them valuable for injection molding compounds with polyvinyl acetal resin. These plastics may contain 5 or 10% of *Neville Resins*, and may be ground with pigments and molded on

Physical Constants of Cumarone-Indene Resin

	Indene	Cumerone
Index of refraction	1.571[12.7]	1.565[22.7]
Melting point (°C)	—2	<—18
Boiling points (°C)	182.4	174°
Molecular weight	116.15	118.13

°169° is the starting point.

injection presses at about 340 to 380° F. Such articles as combs, spectacle frames, sun glasses, buckles, and costume jewelry are produced. Strong, light-weight transcription records are also manufactured from a combination of these resins and polyvinyl acetal.

Cold Molding

An interesting cold molding compound may be made with Alberene dust, *Mineralite,* fuller's earth, talc, sand, asbestine, asbestos fines, or calcium carbonate, and *Nevindene.* Alberene dust is a soapstone passing almost entirely a 200 mesh sieve. It may be incorporated in *Nevindene* in equal proportions or less to give extremely hard masses, by melting the *Nevindene* at 200° C and slowly stirring in the filler. Such compounds are opaque, but readily pigmented in all but the pastel shades. Toughness and tensile strength may be improved by as little as 10% ethyl cellulose. These two properties may also be greatly improved by incorporation of *Vinylite A,* using as little as 2 or 3%. *Nevillac* must be incorporated as the solubilizing agent in the latter two instances.

Fillers

The fillers mentioned above effect some improvement in the physical properties of all *Neville Resins* by increasing cohesion, and hardness and decreasing thermal shock and brittleness. They have only a slight effect on the molten viscosity of the melt and hence little effect on melting point. On the other hand, certain finely divided fillers impart an abnormally high molten viscosity to the melt which varies with the filler and its nature. Such materials include mica, certain diatomaceous silicas. As little as 1 or 2% of one certain material of the latter class gels *Neville Resins,* irrespective of the temperature it sharply raises the melting point of the resin. *This may be an approach toward producing a non-thermoplastic material from a thermoplastic resin.*

A recent development in molding involving *Neville Resin* embodies a new principle. The resin and certain clays are combined, pressed and baked, the resultant product having properties of a heat-hardened or thermoset material. Objects molded in this manner are unaffected at temperature as high as 450° F, are hard, shock resistant, and unaffected by water and aqueous solutions. Color pigments may be used to obtain white, pastel or other colors.

Ethyl Cellulose

Work done by producers indicates that a composition of 80% ethyl cellulose and 20% *Nevindene* gives as high tensile strength as may be obtained with any other materials and ethyl cellulose. Ethyl cellulose of very high viscosity, say 250 grade, is an excellent compounding material with *Neville Resins* for the production of cold molding compounds. A typical formula is given below:

Formula No. 21
45 parts R-16 **Neville Resin**
15 parts Hard **Nevillac** resin
15.5 parts **Nevinol**
15 parts ethyl cellulose, 250 viscosity
10 parts imported **Ceresin** wax 190°

This binder has a cube-in-mercury melting point of about 117° C and is compounded with wood flour, using from three to five parts of the binder to 15 to 20 parts of the filler. Experimental work in a Carver laboratory press under 5000 to 15,000 psi at 115-120° C gives objects possessing hard, glossy surfaces which sand well. A nail may be driven through a 1⅛" diameter cylinder, 1½" long without splitting. Specific volume of the object is 22.5 cu in per pound. END

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Thermosetting Materials

(Continued from page 28)

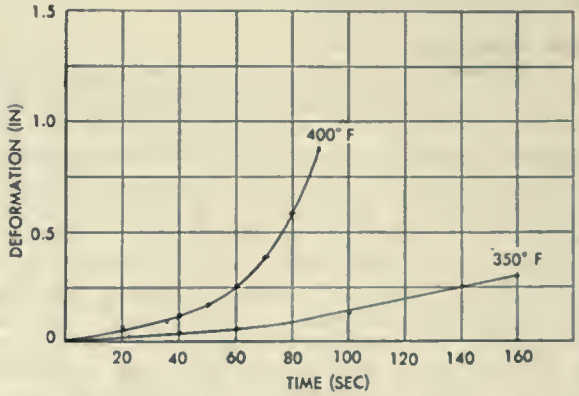

Fig. 8. Deformation characteristics of "Formica CN-11" of 0.248" thickness. Maximum fibre stress is 1000 psi

Loads were calculated to develop fiber stresses up to 1000 psi for the various beams tested. For effective, comparative results, stresses at 500 and 1000 psi proved adequate for the ¼" thick beam. These stress values are appreciably greater than the 266 psi upon ½" × ½" × 5" beams recommended in Method D 648 for the heat distortion test. Lower stress values of 100 and 200 psi were examined in plotting the deformation of some ¼" thick beams, within the temperature range employed. These lower stress values did not cause large enough deformations to afford ready comparison of results. Rather than resort to higher temperatures for comparison, higher stress values were employed because they provided smooth comparative curves.

Interpretation of Charts

Figs. 1 to 8, inclusive, show typical results obtained in recording the deformation at the center of a 4" span for laminated phenolics loaded under maximum fiber stresses of 500 and 1000 psi. Each curve is the average of two or three runs. The grade C laminate shown in Fig. 1 was fully cured in the press prior to test. Its deformation rate increased almost seven-fold between 300 and 400° F.

The influence of curing time of laminated phenolics upon the high-temperature flow is quite marked, as shown in Fig. 3. Apparently slight undercure in the laminate will facilitate forming. This practice has, in fact, been put into effect in commercial forming grade laminates. Also noteworthy is the similar behavior of 30-min and 120-min cured specimens, indicating that even excessive overcure will not affect

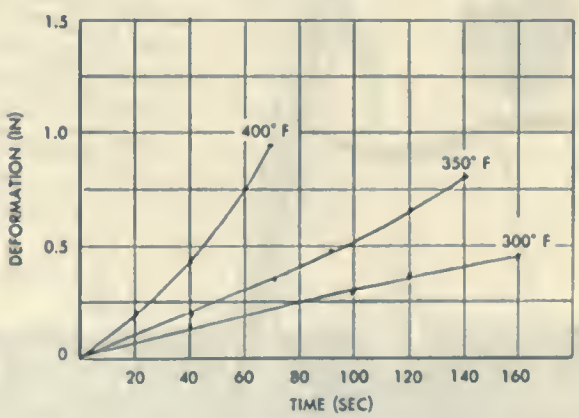

Fig. 9. Deformation characteristics of molded phenolic, 0.250" thickness; wood flour filler. Maximum fibre stress, 1000 psi

the hot formability of the laminated phenolic materials.

It has already been observed in practice that good formability of thermosetting laminates is secured when the cloth is cut on the bias, and this is verified in Fig. 4 where a large difference exists between the bias cut and the straight weave samples. The good flow characteristics of molded phenolic plastics demonstrated in Fig. 9 indicate performance comparable with the phenolic laminates.

The most favorable conditions for comparing thermosetting laminates appear to be an oil bath temperature of 400° F, a stress of 1000 psi, and a material thickness of ¼". Time to reach ½" deformation is reported in the following table.

Material Tested	Thickness (In)	Time to Reach ½" Deformation at 400°F and 1000 psi (Sec)
Grade C—Laminated Phenolic	0.250	125
Formica CN-11	0.248	46
Micarta 444	0.227	72

The fast sweep upwards of the deformation curve appears to be a criterion of good formability or fast rate of creep. Of course, the materials hold their shape after being cooled down to room temperature, though they are subjected to reforming on reheating to an elevated temperature. The test data conclusively demonstrate the thermoplastic properties of phenolic plastics at high temperatures. END

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2 T. S. Carswell, D. Telfair, and R. U. Haslanger, "Influence of Temperature on Mechanical Properties of Molded Phenolic Materials," *Proceedings*, Am. Soc. Testing Mats., Vol. 42, p. 944 (1942).

3 1942 Book of ASTM Standards, Part III, p. 1066.

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5 W. I. Beach—"Plastics and Metals"—PLASTICS, August, 1944.

Compressed Air

(*Continued from page 66*)

part leaves a rectangular-shaped flashing in a particular opening which must be removed. When the company prepared to fill the contract, which is of a confidential nature and can be discussed only in general terms, it recognized that a hand operation would take too long. Dies were made to hold the small piece and air power was applied to the punch for quick, even production. Three of these air-operated punch presses, under the guidance of women workers, help speed the output of a small plastic piece vitally needed by one of the branches of the armed services. Fig. 2 shows one of these punch and die sets, which are operated by bench workers.

There are no comparative figures for the time involved in hand operation; however, the savings may be visualized by going through the hand operation in one's mind. First the piece is placed in a die, then, if hand press is used, the operator reaches for a lever, pulls and then pushes the lever up again. Fatigue would slow down the operator as the day progressed. By air, the piece is placed in the die by hand. Touch of the air lever shown in Fig. 2 completes the punching operation instantaneously. A very conservative estimate would be that air operation moves twice as fast. Air power is used on this operation for the same reason it is used on the big presses—fast, steady, even pressure.

Flashings from the above operation are whisked away with an air hose and every other machine in the plant has compressed air at hand for operators to clean out dies, remove flashings and for other quick cleaning.

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by the company itself and is shown in Fig. 4. The purpose of the operation is to trim a small band-shaped flash from a molded piece, the band being the piece wanted in this case.

The slow method of a hand arbor is avoided by using compressed air. Just as the band is removed, compressed air is automatically released to drive the flashing through a tube, which may be seen in the picture, and which empties into a box at the rear of the machine. The rest of the piece is discarded through a tube at the side of the machine. The operator can more than double the daily output possible by a hand arbor. The company has six of these machines in operation.

The compressed air for the mold presses and other operations mentioned is provided by a steam-driven air compressor operating at 150 pounds steam pressure and with a capacity of 880 cu fpm free air delivery. It serves every section of the plant with air pressure of approximately 85 psi. The compressor has a 12″ bore and a 16″ stroke (Fig. 3).

L. F. Latteman, chief of the engine room where the plant generates its own power, reports that the compressor starts to work at 6 a.m. Monday and runs continuously, around the clock, until 7 p.m. Sunday. A smaller compressor of 350 cu fpm capacity supplements the main compressor during the busier day hours.

Maintenance costs on air compressors is practically negligible. It is the practice in engine rooms to put the compressors on the oiling round and to make periodic inspections once or twice a year. At this time any small worn out parts are replaced.

The chief engineer estimates that 85% of moisture is removed from the air by use of an after-cooler, serving both compressors. Separators located throughout the plant remove other moisture from the air lines.

Practically every piece made at General Industries today is intended for some radar part, an airplane instrument or for other military purposes. The number of employees in the plastics department of the company today (1,000) is approximately 50% higher than the pre-war employment rate. However, the company plans to expand after post-war adjustments are made rather than return to pre-war levels of production. Plans under consideration call for a 33⅓% increase in the plastics department plant facilities.

Fig. 4. Compressed air powers this shearing operation at General Industries; also blows flash into rear container

Still another significant use for compressed air may be found in the extrusion process, as applied by Carter Products Corp., Cleveland. When the die is designed for a thin-wall tubing, air must be introduced into the tubing at the die to avoid collapse of the tubing. Since the tubing emerges after being flush against the die, a semi-vacuum is formed inside the tubing, with the result that atmospheric pressure on the outside of the tubing causes the walls to collapse.

The air line runs through the die and extends into the inner space of the tubing as it comes from the die. The plastics material is forced around the air line back of the die. From 2-4 oz pressure is enough to keep the tubing wall at normal die dimensions.

Carter engineers are also experimenting with the use of compressed air in sizing plastics tubing after it leaves the die. For this application, a higher pressure is used to increase the diameter of the tubing by forcing the wall outward after it leaves the die. With proper engineering, it is believed that production of many different sizes will be possible without changing dies.

Compressed air may also be used in the extrusion of flat plastics, suitable for die cutting and other processing. As the flat material comes out of the long die, a low pressure stream of cooling air is introduced against the continuous strip, thus completing an operation which would otherwise require time for cooling. Extrusions requiring evaporation of excess moisture may be dried quickly with a stream of compressed air.

Of particular importance to the plastics industry is the application of compressed air to extrusion molding of hollow articles such as Christmas tree ornaments and containers. Air is introduced into the mold to force the material uniformly around the inner surface of the mold. END

Phenolics Post-War
(*Continued from page 24*)

emergency by old rope-and-tackle methods. No, that is too slow. The new lifeboats, extending along both sides of a ship are *dropped* from the deck of the ship to water 60-90 ft below by a single release lever on the bridge. They have to be tough, yet light; that's why plastics are used. While the plastics used is not phenolics (it is *Chemold,* a thermoplastics), the new boat is typical of things being done with plastics which no one expects to be done, and phenolics are quite generally used in laminating boats for Navy use.

Cordage fibers, impregnated with phenolics *(Co-Ro-Lite),* have greatly strengthened molded and laminated parts. Combined with bag molding techniques, large shell shapes with compound curvatures and streamline surfaces are possible. The long tough resilient cordage fibers interlock permanently on flat surfaces or around corners, giving impact strength so necessary to such things as boat hulls and cabins, airplane fuselages, and fuel tanks. The fact that neither expensive molds nor huge presses are necessary to the process indicates the economies which may be expected when cordage fibers begin their expanded service in civilian goods. If automobile bodies and truck panels are ever made of plastics, cordage fibers and phenolics will most likely be the materials used.

In any discussion of materials in which phenolics play an important part, plastics-plywood should not be forgotten. Phenolics have contributed properties to wood which artisans of the past never dreamed of. They have removed worries about checking, swelling, warping, distortion and fungus growth which caused old plywoods to delaminate in alternate exposure to sun and rain. Plastics-

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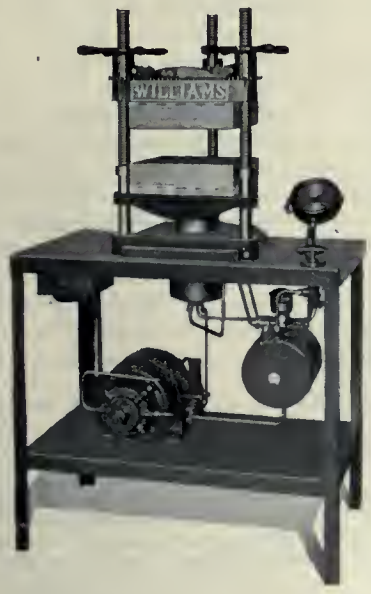

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plywood, impregnated and bonded with phenolics resins or films, can be safely considered a brand new material. Low pressure, and low heat curing resins of recent development, make it possible to mold plywood in almost unlimited variety of shapes. Furniture manufacturers see great possibilities in this new wood, which isn't wood at all. It isn't plastics either, strictly speaking, but a healthy combination of the two which develops new properties never available to furniture manufacturers before. Office furniture, tables, commodes, bureaus, radios, coffee tables, household appliances, window display fixtures, and vehicles for highway transportation are in experimental design and construction by Jasper Wood Crafters, which points out in its printed prospectus that a great new industrial period lies ahead when every manufacturer will have to meet the greatest challenge the country has ever known, and that it will be met with new materials, new methods, and new ideas.

Other manufacturers who have come into prominence by the hundred through their contributions to war production, have used plastics for the first time. In doing so, they envision their postwar products designed and produced from the materials and by the methods they have learned to use well. Virginia Lincoln Co. has designed compact, prefabricated bath and kitchen units molded of plastics-plywood which will save home builders thousands of dollars in home construction and shorten the time between approval of the architect's plans and the day when the owner moves into his new home. The economies of prefabrication, where home units can be built under ideal shop conditions with power tools and skilled workmen as opposed to the slow cumbersome methods of hand sawing and fitting on the job under difficult circumstances, would require a chapter by itself. When these economies come to home builders, and they will come soon, we shall find phenolics in a host of new applications which will lend permanence and satisfaction never experienced before.

Not long ago an English architect, J. Cecil Clavering, was awarded first prize in the IAAS Housing Estate competition for designing a house that only the use of plastics made possible. It was designed of plastics-plywood to achieve light weight (essential to prefabrication), and employed the stressed skin principle of aircraft construction. The material has great strength in tension, compression and shear; is dimensionally stable under a wide range of atmospheric conditions; and is easily worked. The stressed skin principle means that all forces arising out of structure load, contents load, wind load, etc., are transmitted to earth through the plywood skin, eliminating posts, framing, joists, beams and spars, and saving much material and weight. In place of the light framing commonly used, a series of spacing pegs maintained the outer and inner skin firmly in contact and the intervening space was filled with phenolic foam for insulation.

This illustrates an interesting and novel architectural approach to plastics that appears to be sound. The house

One subject on which comparatively little has been written is—

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when completed will make greater use of plastics than any other building yet conceived. Not all plastics will be phenolics but each will be chosen for its inherent advantages. The architect proposes to use styrene for weather-proofing the exterior, because the elastic nature of this material will resist any slight movement of the building members without cracking and consequently contribute to permanence. Also, it will provide good adhesion to the phenolic-impregnated skin and make a wide choice of color available in the exterior finish.

In surveying the future of phenolics, let's never forget that they are chemical materials. We must not expect the impossible, nor depend upon wishful thinking when writing specifications for things to come. Above all, let's be practical and down-to-earth in our choice of materials, whether plastics or otherwise, and we shall have no regrets. There is no universal plastics that can do all things for all products, but there is a specific plastics for almost any engineering problem if its properties are not overestimated or improperly applied. Choose plastics wisely and they will serve you well. END

Acrylics for Tote Boxes

(*Continued from page 74*)

in order to make possible the matching of trays and boxes to have the top surfaces of trays level with the top surfaces of boxes.

In addition to the box and tray designs, a wide assortment of partitions and separators present almost limitless variables in the way of box compartment arrangement. There are also designs for a set of half-round trays with separate covers to be used independently of the boxes in instances where very small pieces only are required at an assembly station.

In the above designing job particular attention was given to the lack of uniformity in the thickness of methacrylate sheet stock. As a consequence, all box measurements shown above are inside dimensions. Only in that way could the proper fitting of compartment insets be controlled.

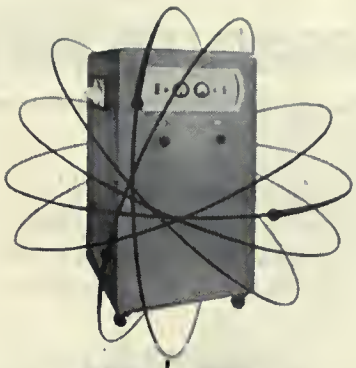
The designers' second assignment was to produce drawings and specifications for a set of completed tote boxes for the initial order.

To assist the designers in this phase of the job, a complete set of the gyroscopic instrument parts was gathered together. Each part was tagged to identify: (1) the assembly station to which its kind was to be delivered; (2) to show the quantity to be delivered per shift; and (3) whether or not the piece necessitated individual compartmentation for extra protection against damage.

From the tagged parts, gathered together in groups corresponding to the various line assembly stations, and from the completed set of box designs, the draftsmen produced a set of assembly station box designs. The set ranged from the smallest independent tray to a full-size box containing tray, partitions and several types of separators. In instances where 15 or 20 different instrument parts must be delivered to one assembly station, or where the parts are too large to pack one shift's supply into one box, as many as 4 boxes are called for at a single station.

A tabulation of the boxes, trays, partitions and separators needed to put together the tote box requirements for the particular assembly to be supplied with plastics tote boxes revealed a total of 4495 pieces of plastic, a box being counted as one piece. The 4495 pieces consisted of 63 different designs; boxes, trays, dividers and separators.

These products were made for us by Dura Plastics, Inc. of New York City. The vendor's responsibility was a



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heavy one. Piece tolerances were held to 0.010", with no allowance for the accumulation of errors in slotting the separators.

Each of the different plastic piece designs carry different Sperry identification numbers and all of the 4495 pieces had to be clearly marked by the hot stamp process with black fill-in.

Furthermore, the vendor order included assembly of the plastics boxes in conformity with the set of assembly station prints and specifications. The tote boxes, as well as the trays to be used separately, were then further identified by application of a 5/8" red decalcomania numeral, conforming to the number of the assembly stations for which they were procured. Decalcomania was used for station identification in order that the number could be removed without damage to the plastic when the original use of the box was terminated or changed. For protection of the decalcomania a coat of clear shellac was applied.

The plastics boxes, with their multiple insets, are considerably more costly than the crude pine boxes with paper separators. It is important, however, to bear in mind the nature of the gyroscopic instruments being manufactured. Cleanliness and protection of instrument parts is of extreme importance. Damage to a relatively few instrument parts could be a good deal more costly than the extra expenditure for plastics totes, the partial function of which is protection of critical pieces against damage.

In the production of Sperry high precision instruments, where improvements to methods and working conditions are constantly being applied, many uses for plastics have been found apart from molded or fabricated parts in the instruments themselves. Cellulose acetate operation sheet envelopes, acetate dust covers of various sizes for work in process, methacrylate or acetate cabinets and cabinet panels, vinyl tubing and butyrate nozzles for vacuum lines are typical of the applications which have been adopted with good results. END

Let the Public Be Pleased!

(*Continued from page* 54)

tendency has been to cover labels with technical and semi-technical details that require interpretation for the layman. The consumer is interested in the qualities of the goods that will serve his needs best.

The post-war consumer will not be like any consumer we have known before. Tens of thousands of men and women have been exposed to new and wider experiences. Although a $30-a-week will replace the $100-a-week salary, the higher income appetite will die hard. A large post-war market will therefore demand the quality for which increased incomes gave buyers the taste. The possibility of applying plastics to almost all products and equipment will frequently make it possible to satisfy this demand.

Pre-production testing, based on design evolved out of actual requirements and tastes, prove that acceptance is only a matter of meeting these needs, and will dispel, in many cases, a vague fear of consumer resistance to change. The same consumer who resists plastics because he identifies them with cheap gadgets, has also patronized stores and restaurants and worked in offices and factories using heavy-duty plastics equipment, without knowing to what the increased efficiency and attractive appearance was due.

When we use plastics to improve the appearance and safety of a worker-manipulated machine or to improve the efficiency and function of some specific household product, we find that the consumer wants exactly what plastics have to offer. They are frequently less expensive and as effective or more effective than traditional ma-

terials. Their use often saves the consumer's time because of ease in cleaning, resistance to scratching, inherent finish and other invaluable attributes.

The home is the traditional stronghold of change resistance. Tastes in homes are often wholly dictated by sentiment and familiarity. Yet we find that the use of plastics in combination with other materials in kitchens in particular indicates that plastics will be received in exact proportion to their efficiency. The conclusion is simple: The kitchen is a workroom. It is one of the few rooms in the home where tradition plays little or no part. A housewife does not cling to an old-fashioned stove or an easily stained, chipped and inconvenient sink in the same way that she cherishes the ponderousness of the golden oak period in which she grew up. This distinction is one which should be given more attention by the designer.

In terms of energy and time consumed in the preparation of food and the cleaning up of kitchens by the housewife, science and invention have made her job twice as easy. The use of new materials, among which plastics will undoubtedly be outstanding, will make it twice as easy again. Thus, plastics can, and probably will find their way into the estimated 10,000,000 American homes through the kitchen door.

The home is only a very small part of the high potential of accumulated demand, which includes more than 10,000,000 automobiles and 20,000,000 radios. All of these are direct, consumer-used products through which he will become familiar with plastics in action. Because of durability, high tensile strength, light weight and the inherent finish of many plastics already developed, they are already being applied in the design of cars, trains, airplanes and buildings. It is at this point—before production—that industrial design becomes the range-finder for new products and new markets. It can give direction to many industrial moves which have too often been controlled by the sales manager's hunch or last year's product failures, and usually have no bearing on what may be this year's success.

Too much emphasis cannot be placed on a "grass root" knowledge of the markets. Although a drill press operator may use his machine with a lessening of fatigue and increased production because of appearance and efficiency due to correct design, and probably the use of plastics, he becomes another consumer altogether as a private citizen buying goods. As a home-owner, there is a close association in his mind between traditional forms and traditional materials. Yet from the standpoint of function, durability and easy maintenance, plastics will be the most desirable materials for many pieces of furniture. Dining tables, end tables, furnishings for children's rooms, and the like, which are subject to hard wear, may all be plastics when they can offer appearance and durability competitive with traditional woods.

The major question that the plastics industries must ask themselves is, "Who is the consumer?" and "What are his specific requirements?" not, "What can he be sold into buying?"

An example of this approach might be the vacuum cleaner. We ask first, "What is the consumer's cleaning problem in relation to his income group?" "What facilities does he have for storing equipment?" "What things will he want to clean?" "How long does it take?" A much more extensive analysis is necessary, but these few questions illustrate the point. The vacuum cleaner is an outstanding example of a piece of home equipment in which the light weight and other excellent qualities of many plastic materials can be used to advantage. The important point to consider is that a correct analysis almost always starts with the performance of the product or material in action, not with the product itself. Preconceived notions of form, application and other super-

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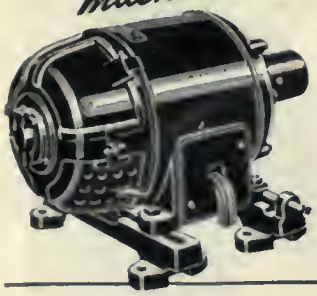

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ficial characteristics only limit potentialities—and sales.

Briefly summarized, there are eight steps in design approach: Research into consumer requirements; evaluation of pertinent trends; product analysis; specification of product requirements; measurement of consumer preferences; application of materials and technical developments; visual design; design selection by consumer tastes. These have many subheadings and secondary benefits, such as advanced product ideas, related products, accessory products, and creative material for advertising and sales manuals, as well as new ideas for merchandising and new processes.

A highly-trained consumer research department to investigate requirements and pre-test acceptability, a technical staff to analyze product requirements and develop new and improved products, a technical research department which constantly studies new materials and technical developments, and a design and engineering staff to develop final product designs, are all necessary components of the complete picture. Insofar as materials are concerned, plastics, more than any other, have taxed the ingenuity of the industrial designer, yet promise him many opportunities for broad improvements in product design. END

Resin Fibre Preforming

(*Continued from page* 42)

at the time of the mixing of the slurry. However, an unlimited range of colors can also be procured by painting or spraying in the final operations. This material lends itself readily to baking-on processes and some very attractive deckled or wrinkled finishes are resulting from this method. In the production of hostess lunch trays for airliners as shown in the accompanying photographs, appearance was one of the primary requirements. Highly satisfactory results were obtained by a baked on two-tone color scheme in the final design.

There are several methods of obtaining a harder and a higher polished outer surface on molded articles by applying extra resins to the surfaces of the preforms before the final molding operation. This application is usually done by spraying a resin solution on the preform.

To-day the production costs of the fibre preform ranges from 5 to 20c per lb, depending to a great extent on the complexity of the contour. To this must be added the cost of the impregnating resins used. The variation in the final cost of the fibre preform molding depends upon the volume of production, tooling costs, the timing cycle, etc., in approximately the same ratio as in other forms of molding. As more efficient techniques are developed in the manufacture of preforms by the use of high-frequency electronic heating, reduced pressure vacuum ovens and infra-red ovens, there will be some reduction in production costs. However, the major impetus toward lower costs is expected to result from the progress made in the discovery of new and less expensive resins. Even under present conditions, the prices of fibre resin materials are decidedly favorable when compared with other materials of comparable high mechanical properties.

In recent tests some very interesting results have been obtained by varying the resin content of the resin-fibre mixture. When the resin content was held at 55% of the mixture, the tensile strength was 13,400 psi. When the resin content was lowered to only 15%, the tensile strength was effected only to the point of 12,200 psi. Although the resin content was dropped 40%, the tensile strength was effected only approximately 10%. On the same test impact strength on a notched Izod test varied from 1.09 $\pm$ 0.18 with 55% resin content to 6.96 $\pm$ 0.64 with 15% resin content, thus demonstrating that most of the good me-

chanical qualities are a result of the properties derived from the fibres. However, water absorption of the finished article was controlled almost wholly by the resins. A 55% resin content allowed only 0.24% water absorption over a 24 hr period. At 15% the water absorption jumped to 70.6% for the same period of time.

Table 1, developed from recent tests, brings out some valuable comparisons of properties between the materials fabricated by impregnating after the preforms were made and by incorporating the resins in the beater before preforming. While some noticeable advantages are gained by beater dispersion, more than double the pressure is required than if the preform is impregnated after shaping. However, when volume production is to be considered, the beater dispersion process is more satisfactory. It is simpler, there is better control of resin content, fewer operations are required, and for long runs it is less expensive.

Tests made on samples prepared by either method compared more than favorable with samples of the same resin content molded by other methods.

Continuous research is uncovering new sources of fibre for new properties and greater strength. Among these sources are kraft, sulphite, rag, alpha, ground wood, waste paper, glass, and many different combinations of these. Each of the fibre fillers have a direct effect on the physical properties of the finished materials as is shown by Table 2.

The Hawley company has recently licensed several nationally-known manufacturers to use its processes in experimental and manufacturing work. While many of the actual results are not available for publication at the present time there are indications of successful application of such processes as contact-laminating resins to impregnate pulp preforms, which would eliminate the necessity of pressure in the final operation.

Rope Fibres

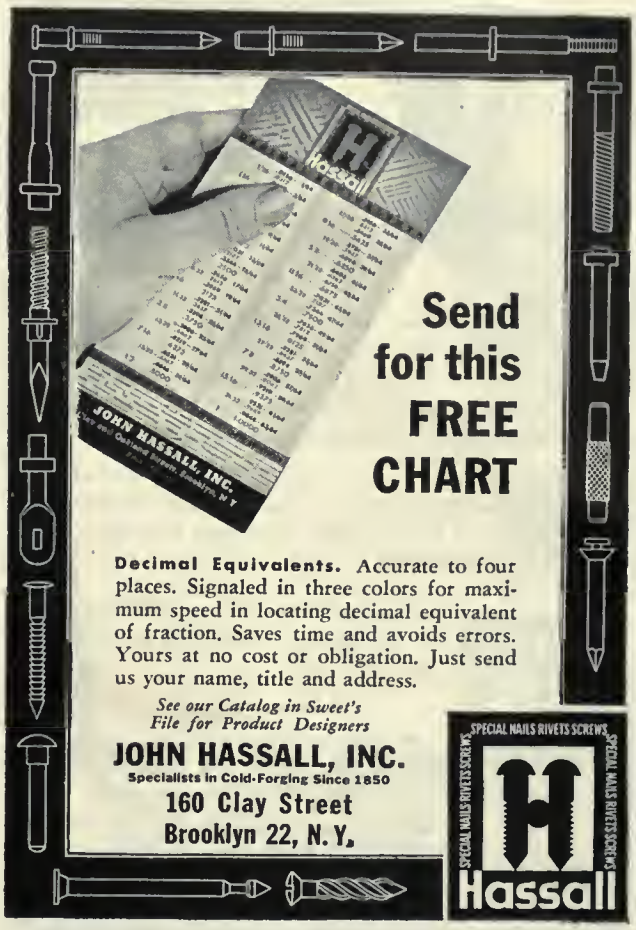
Another interesting fibrous material that is gaining in popularity in preform molding is hemp or sisal fibre of the type ordinarily used in the manufacturing of rope. The process of manufacture with this material is somewhat different in its initial stages but the resulting articles have many of the advantages obtained by the vacuum screen method.

In using sisal or hemp a rough layer or mat of this fibre is made. The resin is then impregnated into the porous material. After thorough impregnation a preform is cut out of the mat in the shape of the article to be made. It is usually put through a simple shaping operation. While this preform does not conform as accurately to the shape of the finished product as does the preform made by suction screen in the paper pulp process, the finished article has the same characteristics. These preforms are usually molded by regular compression methods.

Various properties are being obtained by building up the fibre mats with layers of different resin content. By using layers containing different colors, different hues result on the inside and outside of the article.

Physical Properties Attained with Molding Processes

	Preform Impregnated	Impregnated, Beater-Dispersion	Wood Flour Filler	Fabric Filler Phenolics	Paper Laminates
ding pressure—psi	880	1900-2000	2-3000	3-4000	1500-2000
ile strength—psi	15-16,000	18-20,000	6-7000	6-8000	7-8000
ural strength—psi	16-18,000	21-23,000	7-800	10-11,000	15-16,000
act strength—ft lb r in notched	3.0-3.5	3.5-4.0	0.28-0.40	2.5-3.0	2.5-3.5
er absorption— , 24 hr	0.9-1.0	0.8-1.2	Less then 0.5	1.0-1.5	1.5-2.0



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Rear, front views of resin-impregnated paper pulp welder's mask, an application requiring high impact strength

By varying the amount of resin used on the center and outside layers almost any degree of hardness can be obtained on the surface of the article without using a high resin content throughout the entire thickness of the article. This means a considerable savings in cost of the more expensive resins. The use of this cordage type of fibre filler in preforms produces a molding material readily adaptable to compound curved surfaces requiring an especially high impact strength.

Interesting tests are also being made with different types of resins. Up to the present time most resins used in manufacturing have been of the phenolic type. Tests using melamine resins are producing materials with all the characteristics and advantages of this resin that are obtained in compression molding. The finished articles are odorless and tasteless, and can be produced in lighter shades than are possible with phenolics. END

Cutting Magneto Head Rejects

(*Continued from page* 65)

high frequency the percentage of rejects dropped below 5%. The complete cycle for molding one of these heads is 12 min. Allowing time out for lunch and two short recess periods, production is now 35 heads per press in an 8-hr shift. Production prior to installation of the Thermex was less than half this amount.

Operational costs, including amortization of the high frequency unit used on this job, are approximately 17¾¢ an hour. This estimate is based on the assumption that electricity for industrial uses is obtainable at 1¢ per kwh, and that power and rectifier tubes might have to be replaced after being used 5000 hr.

Heating Other Materials

Because it eliminates the obstacle of low heat transference, high-frequency heating of plastics may be used to advantage with almost all common plastics materials. Thermocouple readings show reasonably uniform temperatures throughout the mass, near the sides, and at other points including the center. This applies to thick sections as well as to thin. Preheating requiring as long as 30 min, using conventional methods, may be reduced to 1 min or even less when high frequency is used.

This quick, uniform heat generation, because it insures a soft pliable mass, means that comparatively little pressure is required to fill the mold completely and quickly. The size

and complexity of pieces can be increased while pressures need be no greater than those already in use. The time saved in mold closing is considerable.

In the general-purpose materials, such as the wood-flour phenolics, molding pressures can be generally reduced to 50% of that formerly used. Closing cycles can be reduced to 30% and curing cycles to 50-25% of that previously used.

In the improved high-impact materials, the advantages are even greater. It is possible to reduce molding pressures to 20% of the time formerly considered necessary, and molding time to 25%. Curing temperature reductions are similar to those effected in the general-purpose materials.

In the special-purpose materials, high frequency heating greatly broadens the scope of plastics uses. In fact it is now possible to visualize the molding of thermosetting materials as approaching punch-press operation. END

Precision-Molded Instruments

(*Continued from page* 80)

Physical Properties of "Plexiglas"

	Sheet	Moldad
Specific gravity	1.18-1.19	1.18-1.19
Hardness		
Mohs	2.3.	2.3
Rockwell	M70	M70
Brinell (500 kg 10 mm ball)	18-20	18-20
Tensile strength (psi)	5800-8000	4000-6000
Elongation at failure (%)	2 (min)	1-5
Flexural strength (psi)	14,000-16,000	10,000-15,000
Compressive strength (psi)	11,000-13,000	10,000-15,000
Impact resistance (ft-lb, ASTM Charpy unnotched bar)	3.4-3.6	1-4
Modulus of elasticity (psi)	$4\text{-}6\times10^5$	—
Coefficient of expansion (°C)	8×10^{-5}	$8\text{-}9\times10^{-5}$
Water absorption (%) by weight (not pre-conditioned)		
24 hr.	0.6 (min)	0.4
48 hr.	—	0.5

The materials of which the drafting instruments are now made are rigidly controlled chemically during their manufacture. Furthermore, the precision methods of molding maintain exacting controls during the molding process and provide for normalizing after molding. This maintains the uniformity of these products, and eliminates the ills of the imported (from Japan) wood-and-bamboo product which was susceptible to high water absorption, warping, twisting and splintering. END

Comparative Properties of Dow, Bakelite and Monsanto Polystyrene

Property	Dow Chemical Co.	Bakelite Div. Carbide & Carbon Chemicals, Inc.	Monsanto Chemical Co.
Specific gravity	1.055	1.07	1.054-1.070
Specific voluma (lb per cu in)	26.3-25.9	25.9	26.3-25.9
Refractive index (nD)	1.59	1.592-1.597	1.59
Tensile strength (psi)	7000	6500-7000*	5000-9000
Modulus of elasticity (psi)	$1.7\text{-}4.7\times10^5$	$0.375\text{-}0.425\times10^6$*	$1.7\text{-}2.6\times10^5$
Flexural strength (psi)	16,000	14,000-19,000*	14,000-19,000
Hardness (Rockwell)	M75-M90	M85-M92	M87-M90
Specific heat (cal/°C/gm)	0.32	0.32	0.32
Thermal expansion (per °C)	$6\text{-}8\times10^{-5}$	$65\text{-}75\times10^{-6}$	$6\text{-}8\times10^{-5}$
Heat distortion (°F)	170-175	170-176	170-180
Dielectric constant (at 10^6 cycles)	2.5-2.6	2.5-2.6	2.5-2.6
Power factor (at 10^6 cycles)	0.0001-0.0003	0.0001-0.0004	0.0001-0.0004
Effect of acids	Attacked only by strong oxidizing acids	Oxidizing acids cause slight discoloration	None
Effect of alkalies	None	Excellent resistance	None

*Used in injection molding.

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Testing Plastics Rivets

(Continued from page 62)

indicate that high-temperature *Lucite* offers satisfactory stability at a wide range of temperatures, while *Lumarith* is very good at extreme low ranges.

The tests were performed in the Scott machine, and the varying temperatures were achieved with dry ice packs and infra-red lamps. Both rivets were ¼" in diameter and were of the 100° countersunk, ⅝" L ⅛" bore type. The *Lucite* rivet weighed 0.0254 oz. and the cellulose acetate units weighed 0.0284 oz.

Experiments to determine the relative shear strength of the *Lucite* rivets driven through phenolic (*Micarta*) sheet, produced the following results in single shear:

Thickness of Sheet (In)	Failure (Lb)	Remarks
1/16	55	Sheet failed
3/32	125	Rivets failed
1/8	142	Rivets failed

The company finds that plastics rivets greatly reduce time and labor required to fasten plastics to metal, wood or fabric, and they make possible many desirable and advantageous changes in design because they do not require access to both sides of the work. They also possess decorative features, are non-corrosive, and make possible certain joints which formerly had to be made by objectionable or very expensive means. Where maximum strength is necessary, the 100° countersunk rivet is best, but where strength is not important, either the flat head or brasier head rivet is satisfactory.

The tests showed that it is highly important to keep hole size in shank, temperature, time of heating and air pressure in proper relationship. Rivet length may range as far as desired, as long as the bore extends the correct distance through the shank. The expanded portion can be as short as 1/16".

END

Machining Plywood

(Continued from page 48)

the appearance of having many fine nicks. These nicks are the points that contact the glue lines.

Some thought is being given to the use of oscillating heads wherever possible in the machining of plywood, so that the tool wear will be more evenly distributed. However, this is not feasible in dovetailing.

Shearing and Punching

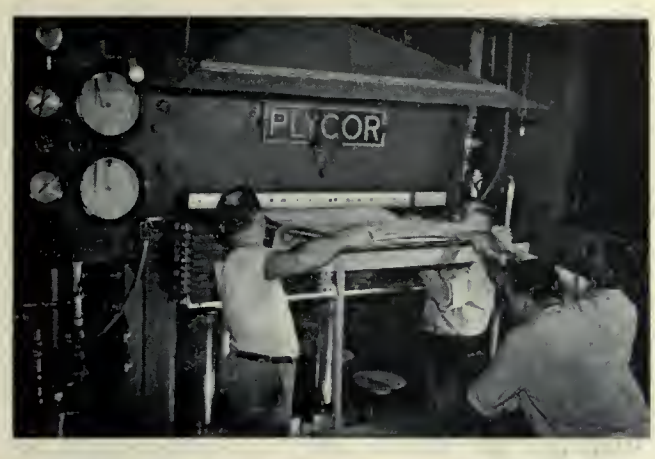
Thin plywood, such as is used for 1/16" 3-ply aircraft skins, is often sheared in power shears. Because of the differing grain directions, the power shears must be rigid and rugged in order to provide clean cuts.

Thin plywood is often punched. As with shearing, the danger is in crushing or mangling the edges. Sharp dies with proper clearances and firm beds are essential.

Scroll and Jig Sawing, Chain Mortising

Both sawing operations are common in plywood applications. A music panel on a piano is a good example of these techniques.

Chain mortising is frequently used in door construction, and a common application are the plywood stiles in the lightweight honeycomb type flush doors. The plywood glue lines are rough on the chains; however, proper honing of the chain cutters gives reasonably long life.



Experimental panel being put through one of openings in hydraulic hot press, capable of pressing 10 panels simultaneously. Note only 2 of the 8 rams in press are in use

In many aircraft assemblies it is necessary to handplane the $\frac{1}{16}$" or $\frac{3}{32}$" thick plywood edges. This is often troublesome. Here is a useful application for the new electric power planes. The spiral cutters, operating at 15,000 rpm and over do a very fine job.

Humidity Control Systems

Up-to-date plants using and machining resin-bonded plywood are installing, or have installed, humidifying systems to give moisture content control. The value of these systems cannot be overestimated, and their use is required for top rating contractors by the Army Air Forces, wherever plywood assemblies are fabricated. Dust collector systems, too, are required, and are even more necessary for resin-bonded plywood than they are for solid lumber.

Nothing has been said about machining the new superpressed plywoods, which are generally impregnated with resins and then bonded under heat and very heavy pressure, with or without additional layers of resins between the veneers. *Compreg* and *Impreg* are examples of this type of wood. The densities are much heavier than normal resin-bonded plywood and they more nearly approach the true plastics. Machining problems are quite different in the case of these heavy density plywoods. END

Cutter Tool Economy

(*Continued from page* 60)

resharpening before application on another job—which alters the dimensions of the cutting edge somewhat. For this reason the sample bites intended for the bite board should be those taken not when the tool is new and before it has been used, but after it has completed a job. The after-use sample bite will show the actual contour available from the cutter for the next use, as well as the condition of the available bite. When the tool is used on another job, especially one that is long enough to have an appreciable effect on the cutting edge, a new sample bite should replace the old one on the bite board.

In plants where the stock of cutter tools is large, it will take some time to sample them all in order to organize the bite board, since the process requires the setting up of each tool to take each sample bite. But once this has been done and the bite board completed, it is then only a matter of conditioning the machine operators to the habit of taking a sample bite on an acrylic wafer at the end of the run and before demounting the cutter from the machine. END

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Hand Tools

(*Continued from page 34*)

at temperatures ranging from 185 to 248° F. On the other hand, it burns easily, a factor to be considered in high temperature applications, such as on airplane engines. It is significant, however, that few safety engineers have ever objected to the use of this plastics, and no adverse "flash" experiences have been reported.

Screwdrivers with cellulose nitrate handles are still widely in demand. Extruded 6 to 8 flute, the profile can be varied for individual tastes, the handles being drilled at one end for insertion of the tang. Manufactured in a variety of sizes and styles, from vest pocket to cabinet types, they are ribbed to offer a positive grip and are unbreakable and shockproof. They are transparent and brightly colored, and come in lengths and diameters that are ample for comfortable use.

One use of this extruded plastics is the double handle grip of the inertia starter airplane crank handle. It has a deeply grooved outer surface which affords an excellent hold. It is light in weight and has great impact strength. Because of its toughness and weathering qualities, cellulose nitrate is particularly adaptable for trowel handles, and for the handle grips of hack saw frames. Its smooth surface makes it ideal for the brace heads and handles, and its shockproof qualities make it ideal for socket wrenches. The handle is ribbed for a tight, firm grip and can be spun around easily.

For smaller-sized handles, molded cellulose acetate is widely utilized. The reason for this is that a small diameter (less than ½") permits the operation of a fairly rapid molding cycle, so that production costs are less than when equivalent sizes are machined from cellulose nitrate rod. The trend to injection molding of tool handles is growing, encouraged by improvements in molding machines which, because of expanded capacity, decrease per-unit costs. Better molding materials and slow-burning plastics are other reasons for this trend.

Laboratory tests have proved that cellulose acetate is excellent for injection-molded screwdriver handles. These tests, which were extremely drastic and were designed to approximate service conditions, showed that the impact strength of the acetate is greater than that of cellulose nitrate. Even when the steel itself started to bend under repeated hammer blows at –40° C, the plastics handles stood up satisfactorily with no cracking or mashing. It showed excellent toughness at all temperatures tested, and only off-center blows marred the handle face. When heavy blows drove the tang completely through the handle, it did not crack or split.

Tests showed also that the acetate has good resistance to burning, and the flame, when finally started, can be extinguished by blowing. An excellent grip of the plastics handle on the steel bit can be achieved by knurling the bit and making it slightly over-sized before forcing it into the handle-hole.

What, concretely, are the comparative costs of injection molded (cellulose acetate) handles and turned (cellulose nitrate) handles? Recent laboratory investigation revealed the following: Injection molding costs less than machining from the nitrate for all-plastics handles up to ⅞" in diameter, assuming a certain minimum of output. For larger handles, the situation is reversed.

It must be borne in mind, however, that the initial high cost of the production mold ($1500 and more) may make injection molding uneconomical unless there is sufficiently great demand for handles of that particular size and shape.

On the other hand, cutting tools for the turning of a handle on a screw machine cost only $25 to $60. The decision as to injection-molding vs rod machining should be based on careful consideration of these factors as well as on relative physical characteristics.

A major difference between the acetate and cellulose acetate butyrate, both of which are utilized in injection molding, is that the latter has lower moisture absorption, is somewhat lighter and is more dimensionally stable. There is a slight price differential but this is neutralized by the difference in specific gravity. Butyrate is well adapted as a fluted rod for screwdriver handles, and is also used for the small end of a handy wrench that is familiar to Army mechanics in the airplane industry. Extruded butyrate, as well as acetate, up to 2″ in diameter is in heavy demand by the armed forces and is high on the priority list.

The varying qualities of the different plastics enable the manufacturer to choose his material in accordance with the particular requirements of the tool. Molded ethyl cellulose, for example, is neither too warm nor too cold to the touch because of its low thermal conductivity and it has good dielectric resistance. For these reasons, it is ideal for bayonet handles, enabling the soldier to cut electrified barbed wire with his bayonet in perfect safety. It is used also in wrench handles. Cellulose acetate is used for the housing of rotary pneumatic drills, enabling women to operate them accurately and without succumbing to fatigue.

Casein, again, may be preferred by some to cellulose acetate, because it is harder and has more sheen and luster. Especially adapted for smaller tools (from $\frac{5}{16}$″ to ½″ in diameter) such as are found on the jeweler's workbench, casein is extruded and has the advantage of comparative cheapness in price of the plastics itself. It is used in the handles of neutralizing and alignment screwdrivers and wrenches and for test prods, which may be all-plastics, except for the prod-tips. It is used also in tuning tools which check the alignment in radio receivers. Casein, on the other hand, is not utilized where good dimensional stability is needed, since it has high moisture absorption, compared with the other materials mentioned, and could not be extrusion-molded without a formaldehyde treatment *after* extrusion.

Two examples of the use of plastics in tools as functional parts that carry out the purpose of the tool more efficiently than wood or metal are soft-nosed hammers with celluloid tips or heads, and all-plastics fuse-pullers.

For hammering soft metals or delicate machine parts so that no marks or indentations result, mallets with heads of cellulose nitrate are used in various sizes by jewelers and aircraft mechanics. A particularly handy tool is a small clawless hammer with one end of the head plastics and the other end metal, so that hard and soft blows can be struck interchangeably. Some hammers have the heads screwed onto studs so they can be replaced; others are forced on permanently.

Soft face hammers of various styles and sizes are available for almost any type of assembly job where delicate machine parts have to be struck. These plastics heads are especially useful in aircraft plants for the working and forming of light sheet metals. One hammer has a regular cellulose nitrate face on one end, with a brass insert in the plastics material on the other, for work on pins and studs of small diameter and for hard surfaces. Other types have a square tip on one end and an offset peen on the other, or a straight peen combined with a cross peen or a ball peen on both ends. With the same size in tip studs, the tips are interchangeable. Such hammers range in price from 95¢ to $3 per hammer, the extra tips

ANNOUNCEMENT

Ivorycraft Company, Inc., announces that it has moved its place of business to Room 701, Bank of Manhattan Company Building, In Long Island City, and is now in the process of liquidation and dissolution. It has not sold its name, nor good will, nor the right to continue its business to anyone, nor has it any connection with any other organization.

A claim has been circulated that the Ivorycraft Company, Inc., has changed its name to Ned G. Levien Company. This statement is false and contrary to the fact.

Ned G. Levien, President of Ivorycraft Company, Inc., has established his own business under the name of Ned G. Levien Company.

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ranging in their cost roughly from 25 to 80c each.

In fuse-pullers, the transparency as well as dielectric quality of cellulose acetate is utilized functionally. When the fuse inspected is in good condition, contact causes a bulb to light up in the interior of the pliers and the light is visible to the service man. The end terminals can be opened also for testing base receptacles. Toughness is a "must" for this plastics, for utility service men bear down heavily on their pliers. Impact strength is another important requirement; since it saves time when tools can be dumped unceremoniously into a carton for prompt shipment without the need for protection. These all-plastics pliers, retailing for $2.75 each, have stood the test of the roughest handling with not a single casualty reported.

Tool handles are made also of cast resins in various colors. Unlike molding plastics, which are shaped under heat and pressure in closed steel molds, cast resins are produced by pouring liquid resins into open molds. The process starts with a master steel arbor with specifications determined by the piece to be cast. It is dipped into molten lead which causes the lead shell or mold to be "frozen." This is then filled with casting resin and oven-baked. After the resin hardens, the solid casting is knocked out of the mold, machined and polished.

Phenolic cast resins selected for tools have high dielectric strength, low water absorption, good chemical resistance, low heat distortion and good dimensional stability. In these respects, they compare favorably with the thermoplastics. They have excellent machinability, are easy to turn, drill and saw and can be highly polished.

The economic advantage of cast resins over the injection molded plastics is in the comparatively low machine investment, although the phenolics may cost more than the thermoplastics. For special castings, for example, the cost of new arbors is considerably less than that of steel molds and they also take less time to produce. On the other hand, smaller pieces are harder to make by this process and are proportionately more expensive.

When a cast resin handle is fastened to a tang, the hole drilled in the plastics is smaller than the diameter of the tang. The handle is then immersed in hot water or mineral oil at about 200°F, which temporarily expands the opening so the tang can fit into it. When the handle is cooled, the plastics shrinks upon the metal, assuring an absolutely tight fit.

Phenolic plastics are used also as handles for soldering irons, taking the place of hardwood. They serve a double purpose, acting as terminal conductors and furnishing relief from strain. In some brands, the handle is kept cool at all times by the finned heat-retarding union. These soldering irons are made in various sizes for radio assembly, shop, garage and light sheet metal work at list prices ranging from $3.75 to $7.50.

Die-cast phenolic plastics are used also for the bodies of spirit levels, traditionally made of wood, cast iron or aluminum. Presenting a glossy black surface, they are excellent for this purpose, having great strength and imperviousness to moisture and being less affected by tem-

perature changes than either wood or metal. The top plate is a heavy piece of polished "nickeloid" which sets flush with the body and gives protection to the level glass. When nickeloid became scarce, owing to the war, one manufacturer substituted cellulose nitrate and found it very satisfactory.

As in the case of other industrial applications, the invasion of plastics into the carpenter's and mechanic's kit does not mean the end of wood and metal in tools in the predictable future. Hardwood handles still do yeoman service and steel is still king when it comes to hammering, chiseling, sawing or screwdriving. At the same time, the superiority of plastics over wooden grips and handles plus the favorable cost of production points to their increasing application in tool manufacture. The vast nation-wide post-war building and construction projects spell a boom market for part-plastics hammers, saws, chisels and screwdrivers of every type and description. With wider mass production and improvements in molding processes, the resultant lowering of price may well stimulate further demand. At the same time, the post-war period will also witness an increase in the use of accessory tools whose plastics members will be not merely improved adjuncts, such as grips and handles, but also functional parts of the tool.

END

Heel Coatings

(*Continued from page* 39)

which prevents deflection of and distortion to the core, thus insuring an even and rapid application of the plastics. This method also makes it possible to form molded heels with the heel seat entirely completed within the mold. When the heel is ejected from the mold, it is a finished article, except for minor rapid operations.

The design of the apparatus for the molding process (developed by Pereles Bros., Inc., Milwaukee, Wis.) includes a cylindrically-shaped mold formed of two separable sections, one of which contains a tapered cavity corresponding in size and shape to that of the finished shoe heel, which is to be formed within it. The core is mounted to the mold by means of metallic pins adapted to openings in both ends.

The material employed in the heel-coat molding process has been cellulose acetate. The batch of material fed into the machine hopper must be pre-determined with great accuracy in order to correspond to the amount required for coating the cores. An excess would result in overloading the mold cavities and cause uneven thicknesses.

END

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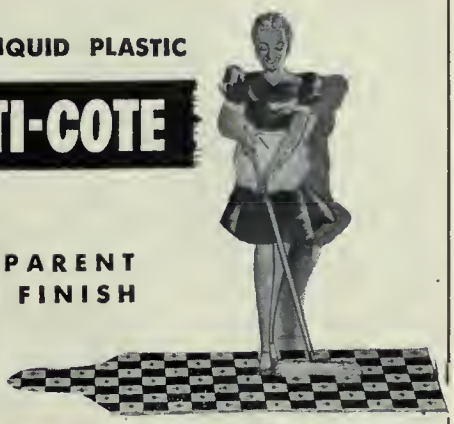

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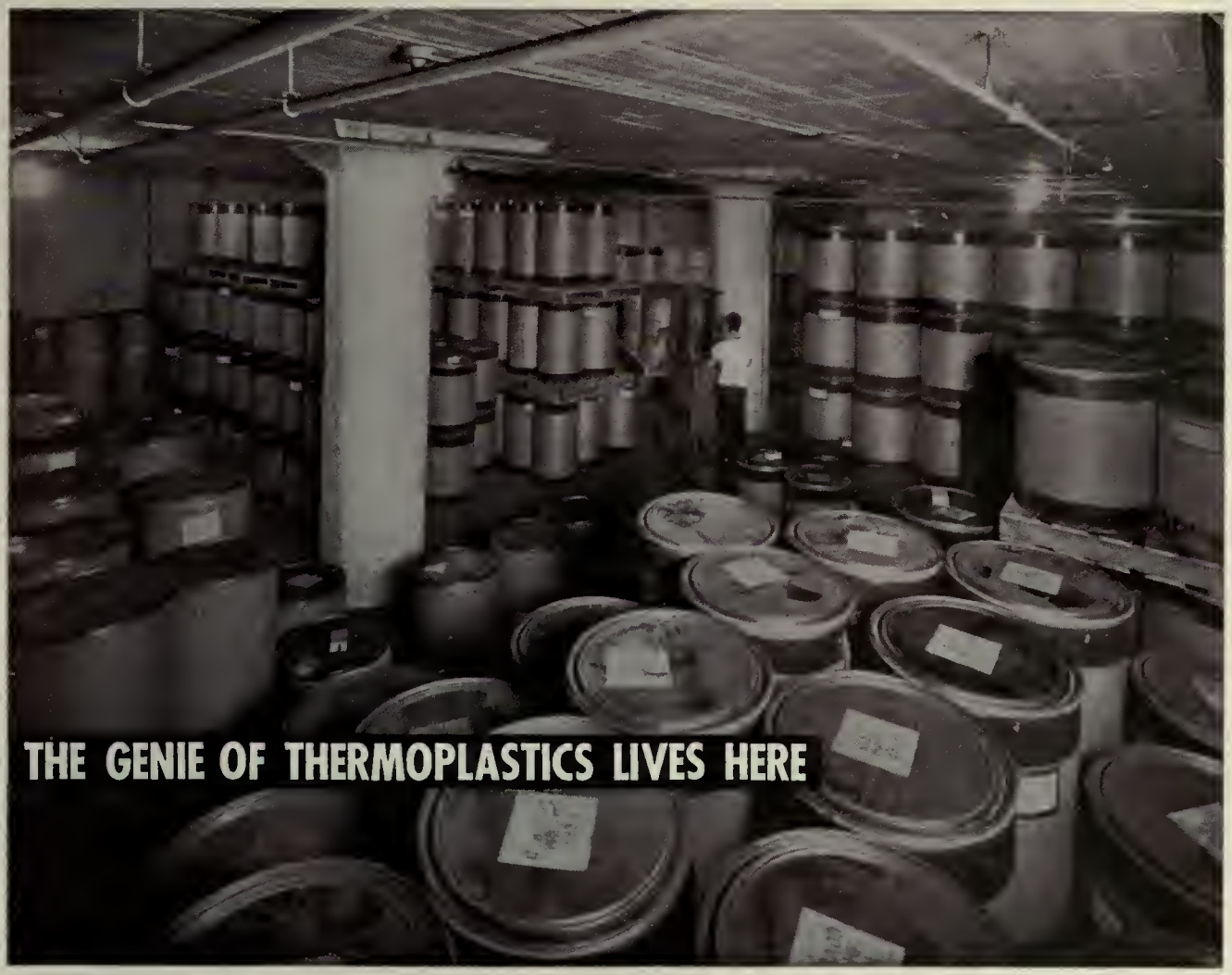

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